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Work for the American Engineering Council

THE change of name from Federated American Engineering Societies to American Engineering Council adopted at its annual meeting at Washington last week, while it makes for brevity and avoids misunderstandings, does not detract one iota from the opportunities confronting the council. Co-operative societies unfortunately have to struggle to make ends meet; but there is nothing to be gained by standing still and bemoaning one's fate. There is plenty to be done of a nature fitting the American Engineering Council. If it will start resolutely and confidently to work out its own salvation, it will be amazed at its own success. It can pursue a course all its own which will not bring it into competition with other national bodies or arouse their enmity or jealousy. That it has suffered somewhat because of these is well known. That these societies have not given the council much serious thought or study is also now generally apparent. The game of waiting is neither pleasant nor profitable, and the American Engineering Council, if it is to realize its highest ambition, must shift the initiative from the shoulders of the engineering societies to its own. It must become aggressive in its own behalf and render such an excellent account that financial support will be given it ungrudgingly, and unrestrained praise as well. Leadership is sometimes won and sometimes seized. It can only be maintained, however, by the excellence of its service.

Cut-and-Dried Public Relations and Their Avoidance

SO MUCH stress has been laid upon the importance of public relations of late that a note of caution should perhaps be sounded against perfunctory practices on the part of utility employees arising from much repetition of good advice about their dealings with customers. In the complex problem of making and keeping friends with the public certain underlying principles must, of course, be followed, and the rank and file of central-station men and women can learn much from their executives; but unless room is allowed for the play of individuality in person-to-person dealings between utility employees and others, a "wooden" sort of relationship results which may turn out very unsatisfactorily in times of trouble.

In some public utilities there has developed a tendency for employees to give "canned" answers to customers seeking for service information in times of operating difficulty. In telephone service, for instance, few things have done more to make the customer feel at odds with the company than his inability to hold a satisfactory conversation with the representative of the utility when the service is below normal. Doubtless there is a correct answer for every one of many hundreds of inquiries which the customer may make in connection with service or rates, but the most successful public relations involve more than the ability to memorize a standard "line of talk" or to quote verbatim rules and regulations which look like unjustifiable red tape to the ordinary citizen, if indeed he does not regard them as designed to put him at a disadvantage.

It is out of the question to expect the average employee to display Court of St. James models of diplomacy in his relations with customers, if, indeed, these could be regarded as suitable to the occasion; but, given thorough training in fundamentals, a courteous and sympathetic interest in the customer's troubles, coupled with a clearly apparent desire to render him the best possible service, will go a long way toward winning his friendship. No manual of salesmanship can take the place of human intelligence in the contacts of the market, and in like manner sufficient latitude should be left to employees who come in touch with customers to permit the fruits of individualism to ripen. Frankness in disclaiming ability to answer unfamiliar questions never hurts either the employee or the company with reasonable people, provided that the matter be properly referred to other channels for settlement.

Superpower Alone Not the Means to Obtain Cheap Power

IT IS becoming more and more generally recognized among engineers that superpower, including hydro-electric and mouth-of-mine plants and big transmission systems and extensive interconnection, will not result in a decrease in the cost of power. It has become clear to them that the necessarily high cost of transmission and interconnecting lines will preclude any real reduction in power production costs measured at the consuming end of the line, the value of these developments lying rather in their maintaining the cost of power at its present low figure and in making possible its more extensive use in all localities. And the more that others study in detail the effects of more extensive superpower development, the more generally will this conclusion be accepted, despite the popular conception of the results of such development which has been inculcated by ill-advised publicity methods.

Entirely aside from the influence of superpower, it is very unsafe to make positive predictions as to the future economic or operating conditions in the light and power industry. Too frequently conditions have changed overnight, and even now the introduction of new steam cycles and higher pressures may bring about a worthwhile decrease in the cost, at the switchboard, of energy developed from fuel. In hydro-electric equipment, however, it is probable that a comparable gain in efficiency cannot be made. In the field of transmission and distribution, on the other hand, practices may be revolutionized in a short period of time. Thus, in spite of the present cheap power, which, in the face of rising prices, has continued to get cheaper relatively as time

has elapsed, it may be possible, with the present general system of generation and transmission, to continue still further to lower the cost of power.

The vulnerable point in the economic array, aside from the steam station, lies in the transmission and distribution system, and the engineering forces of the industry are being concentrated in greater and greater degree to attack this salient feature. Results always follow such vigorous efforts, and a little study shows that the possibilities are good for substantial economies and for some advantageous changes in practice.

Transmission and distribution systems have developed by being built with the engineering knowledge and under the economic conditions existing at the time of installation, and many have become cumbersome, inadequate and extremely expensive in the light of present economic conditions and engineering developments. Underground installations and equipment now involve extremely heavy investments, and they are rapidly reaching a limit in service performance. Transmission lines have become immensely costly structures, which, when high voltage and regulation limitations are encountered, are loaded with expensive and makeshift equipment or equipment that does no productive work—such as synchronous condensers, oil circuit breakers, lightning arresters and transformers.

It is to be hoped and expected that there will be material improvement in the near future, for anything less than the best economic and engineering solution attainable offends the sensibilities of good engineers. But the ultimate means to obtain "cheap power" still lie in the future. It may be connected with electrons, atoms, radium or other agencies or materials, or it may be associated with an unimagined radical revision of existing equipment or practices; no one can say. But, if power is to be produced more economically by present means and if a national power supply is to be obtained quickly, the cost and the service adequacy of trans mission and distribution systems must change continually; otherwise they cannot be maintained at maximum efficiency and take advantage of the continued developments in the art which permit of greater economies. Investments must be protected, but progress must be made.

Range Survey to Reveal Long-Needed Facts

IT MAY seem strange that a thorough analysis of the electric range business has never been made. Yet the fact is that this class of business has but recently reached a sufficient degree of saturation in any one section of the country to make possible the gathering of accurate engineering and commercial data. Advantage of the fact that such a survey is now practicable is being taken by the N. E. L. A. Commercial Section, and at its recent meeting in Salt Lake City a plan was presented by the Northwest Geographic Division by which such vital facts as demand, load factor, diversity, cost of servicing, investment in distribution, substation, transmission and generating facilities will be determined. The electric range has been pioneered in the Northwest, and there are now thirty thousand ranges, one-sixth of those of the entire country, in that part of the nation. Several power companies report a degree of saturation of one range to every five customers for their entire systems. No better field exists for making such a survey as the one proposed.

The committee undertaking the work will be composed of an equal number of engineers and commercial men so that each phase of the problem will receive due consideration. Those companies which have gone after range business actively have not doubted that the business was profitable, but they are not sure just how profitable nor what it will mean with a much higher degree of saturation than now exists. It is to determine this, as well as to establish the rate which should be charged today, that the investigation will be undertaken.

The results of this survey will be watched with great interest because when the report is submitted a year hence it should provide sufficient engineering and other facts to enable every central-station company to determine what its policy should be toward the range business and under what conditions and at what rate per kilowatt-hour it should be conducted. As a public utility, the central station is naturally under obligation to provide electric power for domestic cooking if its customers desire it. The profit in the business, however, has a very direct bearing on the amount of money that a company should invest in the creative development of this market.

Tertiary Windings Have Their Limitations

AMONG the many important developments which have attended the present active expansion in the field of long-distance transmission of power the tertiary winding of the high-voltage transformer presents several interesting features. The importance of a closed delta in star-connected transformers having a grounded neutral on the high-tension side has long been recognized, the principle purpose being the suppression of the triple harmonic components of voltage and the supplying of the third harmonic component of the magnetizing current of the transformers. These functions are so vital that in many cases in which conditions do not offer a convenient primary or secondary delta it has been found necessary to introduce a tertiary delta for this purpose alone. One or the other method is considered an absolute essential from the standpoint of inductive interference with neighboring communication circuits. The presence of the tertiary winding naturally led to the suggestion to use it also for power supply, offering as it does the convenience of a choice of voltage, and it was only one more step in the same direction to use the tertiary for connection of synchronous condensers for power-factor and voltage correction. A still further important characteristic of the tertiary is the low-impedance path it offers for the flow of the unbalanced current in the case of a ground or a short circuit on the star-connected system, thus providing the proper overload currents for the operation of relays and circuit breakers.

The conditions demanding especially the use of tertiary windings are found in the auto-transformers used for stepping up the voltages of existing systems to 220 kv.; in these cases the transformers must operate in star with neutral grounded. In several important cases of this kind this procedure has now been followed for some time. As is always the case in rapid developments of this character, there are indications that not all the advantages offered by the tertiary winding may be used without the possibility of mutual interference. For example, the simultaneous use for power supply and for synchronous-condenser connection can have only a narrow application by reason of the voltage variation

imposed by the condenser. Further, the original idea that the size of the tertiary need be only that required for the circulating third harmonic current was promptly demolished by the excessive heating occasioned by single-phase short circuits. But perhaps the most striking evidence of the limitation of function is the importance attributed by some Western engineers, in the case of a ground and short circuit, to the supply of unbalanced current to meet the requirements of protective apparatus. In order to preserve this feature from all possible interference, in several cases all other connection to the tertiary winding has been excluded. Thus, while the tertiary winding may not be a universal cure-all, it nevertheless offers a wide variety of function, and the proper service for it becomes, as usual, only a question of proper choice and design.

Insulation Impaired by Ionization

IT HAS been suspected for some time that air or other gas entrapped in built-up insulation breaks down under high-voltage gradient with resulting ionization. Simple experiments show the presence of this ionization in thin air films. There has, however, been much uncertainty as to the effect of ionization on the structure and life of the insulation. Defective armature coils and cables have often been found to show evidence of internal chemical action, but the same evidence has been found in insulation still in sound working condition. Considerable light is thrown on this subject by recent experiments of J. B. Whitehead, described in the December number of the *Journal of the A. I. E. E.* Fibrous insulations of varied kinds, exposed to moderate ionization in adjacent air layers, are found to lose both their electrical and their mechanical properties quite rapidly. Their insulation resistance falls, calendered and varnished surfaces disappear, and tensile strength is seriously impaired.

There can be no doubt, in the light of these experiments, that in insulation built up of fibrous materials it is of the highest importance to eliminate air layers and pockets in which such ionization might occur. The case of the high-voltage cable comes first to mind. While it cannot be said that the hot spots in cables, which often lead to breakdown, are directly attributable to this cause, it seems highly probable that internal ionization could start such trouble, and it is certain that, once started, ionization would accentuate it.

The case is quite different with mica, which is shown to be entirely unaffected by copious ionization over long periods of time. In armature bars it would appear, therefore, that while the use of mica naturally increases the likelihood of the occurrence of internal air layers, the mica is proof against the resulting ionization. On the other hand, the fibrous binders of the mica are vulnerable, and in so far as their mechanical properties are affected it would appear that the structural rigidity of built-up mica wrapping must ultimately be impaired.

The experiments cover further study of the behavior of mica under other forms of discharge and show that it is especially vulnerable to sparks playing over its surface. Such sparks appear to lift the thin surface layers, to pick up the smallest surface flaws, and ultimately to lead to complete splintering and failure. The most dangerous condition is a small spark point over an air layer which is backed up by considerable capacity. The capacity increases the volume of spark, and the latter plays over the surface. The experiments explain in considerable measure the well-known value of mica in armature insulations, but they also indicate that even in this type of bar it is of the first importance to maintain a rigid compact structure free from air layers.

Making Rural Service Attractive

AMID the still somewhat confused talk regarding rural electric service there is discernible a thread of thought that seems to indicate the foundation on which the solution of the problem is to be based. The betterment of living conditions on the farm that would ensue from electrification needs no discussion. It has long been realized as a sufficient reason for the demand of the farmers for service. But, turning for a moment to a specialized branch of agriculture, the accomplishments of the Western fruit growers illustrate the thread of thought to which reference has just been made. There are three fundamentals of success in any producing business—quality of product, large-volume production and an adequate method of marketing. A large reason for the success of the Western fruit grower has been the quality of the product he has had to market. This has been brought about by careful methods of cultivation that make older farming methods in the eastern part of the country seem crude. Careful selection has also played an important part. Production methods have been improved until the result is not only an attractive product but a volume of production which will bring a profit at the market price. The third factor in his success has been a marketing scheme that makes him independent of many of the risks that have been and are still so troublesome a factor in other branches of agriculture. Electricity has played a part in this development, first by providing water for irrigation and, second, by making possible the cold-storage plants that have afforded a means of holding the fruit until the market can absorb it.

Success in other branches of agricultural production must come in the same way. In the dairy and poultry industries, for instance, there are possibilities of improving quality by means of the refrigerating plant, and at the same time the products can be handled for the market in much the same way that Western fruit is handled. This is done to some extent in the cold-storage plants of the large marketing centers, but only after deterioration in quality has begun. There is no reason why cold-storage plants that will preserve quality cannot be established close to the source of production. Perhaps the individual farmer, working on a larger scale and specializing on some one product, can have his own individual cooling plant. If this can be done, it will also open the way to specialized markets that are willing to pay more than the market price for a guaranteed product.

There are indications that electricity can be applied in other ways to control the quality of other agricultural products. Witness the experiment in hay and grain curing in Europe. The way is open to fields of investigation that may prove as fruitful as similar investigations have proved in other fields, notably in the electric heating field, where electricity at a higher total cost that that of other means permits a better product, less wastage and a lower final unit cost because of the close control of temperature possible. Cannot electricity render a similar service to the farmer?

Maxwell W. Day

In the foremost ranks of the electrical specialists to whom the propelling and auxiliary equipment of modern battleships and merchant vessels is due.

THE fleet of electrically driven and equipped battleships owned by the United States and the application of electricity to vessels in the merchant marine, both in propulsion and in auxiliary service of many types, have been the outcome of the brains and untiring exertions of technical specialists. Prominent among these stands Maxwell W. Day, engineer of the marine department of the General Electric Company, whose efforts in recent years, though they have included other work for the federal government, have been in the main concentrated on the adaptation of electricity to every possible power requirement on shipboard. He has indeed been identified with the development of electrical auxiliaries on ships, particularly naval vessels, almost from the time when electric motors were first used for marine purposes of any kind.

In connection with this general work Mr. Day identified himself particularly with such problems as the turning of turrets, the operation of guns, handling of ammunition, ventilation equipments, steering gear, anchor windlass, pumps, generating sets, switchboards and various kinds of control apparatus. His long experience and ability have been recognized and appreciated by marine engineers, and the title of dean of electrical marine engineering has been informally conferred upon him.

Mr. Day was born in Honeoye, western New York, in 1865. He attended Williams College, being graduated with the class of 1887 and spending another year in post-graduate work. In 1889 he entered the employ of the Thomson-Houston Company at Lynn on testing and design work. After its consolidation with the General Electric Company and transfer of offices to Schenectady he became a member of the power and mining department under F. O. Blackwell. In 1902 he was appointed assistant engineer of that department in charge of direct-current work. In 1914 he was appointed to the position he now holds. In the earlier part of his career he was particularly interested in the development of mining and hoist work and the general application of motors to factory operation.

Mr. Day holds about fifteen patents covering the control of electric motors. Probably the best known of these concerns the so-called "Day control" for ammunition hoists and boat trains. He is the author of numerous articles and has lectured on various electrical subjects, particularly modern applications. He is an associate of the A.I.E.E. and a member of the Society of Naval Architects and Marine Engineers.

A New England Interconnection

The Line Between the Twin State Properties in Vermont and New Hampshire Saves Building a Steam-Plant Addition—An Analysis of Costs Led to Decision to Connect the Systems

By R. J. ANDRUS
Chief Engineer Twin State Gas & Electric Company, Boston

IN THE latter part of 1921 the St. Johnsbury (Vt.) division of the Twin State Gas & Electric Company found itself facing an imperative demand for additional power service. An engineering investigation indicated two feasible methods warranting detailed study for providing additional capacity. The first, and the one involving the lowest initial expenditure, was the installation of a second steam turbo-generator at the local steam station of the company. The second, and the one determined upon, was interconnection with the Berlin (N. H.) division of the company by a transmission line 52 miles long. The analysis of this problem illustrated in a marked degree the value of interconnecting adjacent systems with diversified loads, hydro-electric and steam generating facilities. The principal features of this study are given below.

The Twin State company is a subsidiary of the Middle West Utilities Company and operates electric lighting, power and gas properties in Maine, New Hampshire, Vermont and New York. The St. Johnsbury division serves St. Johnsbury, Passumpsic, Concord, Danville and Lunenburg, Vt. St. Johnsbury has a large industrial power load for a community of its size. About one-third of the company's revenue is earned from the supply of energy to power customers and 71 per cent of the division's output goes to this class of users.

The Berlin division serves Berlin, Gorham and Milan, N. H. This community has very few industrial enterprises with the exception of large paper mills gen-

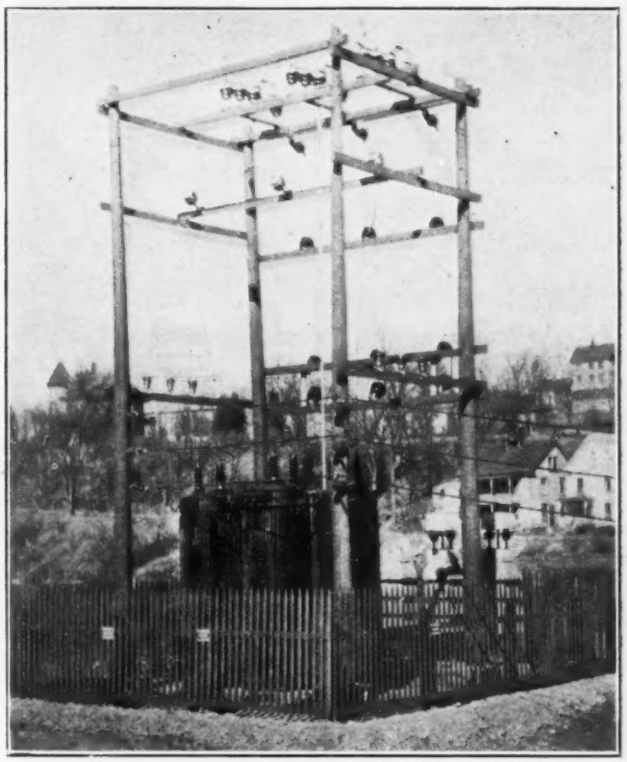
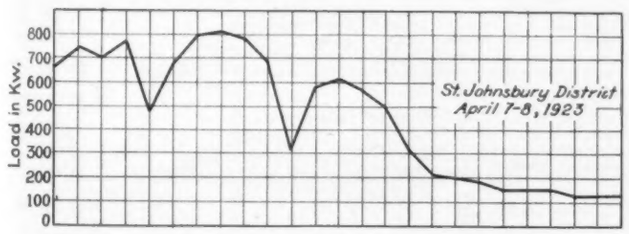


FIG. 3—OUTDOOR WOODEN-POLE SUBSTATION STRUCTURE INSTALLED AT ST. JOHNSBURY



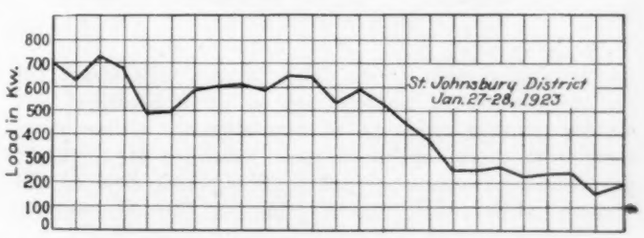
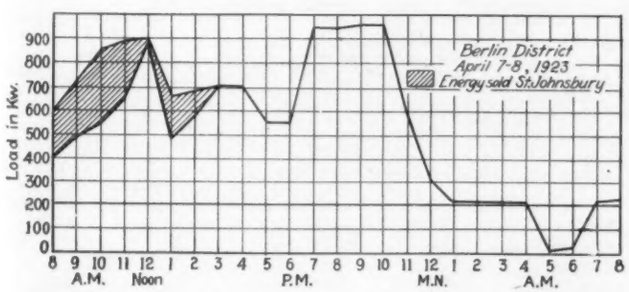


Fig. 1



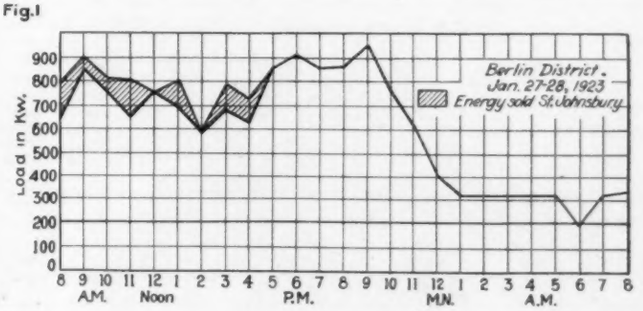


Fig 2

FIG. 1—SPRING AND WINTER LOAD CURVES, ST. JOHNSBURY DISTRICT. FIG. 2—SPRING AND WINTER LOAD CURVES, BERLIN DISTRICT

erating their own power. About 82 per cent of this district's revenue is derived from lighting, heating and cooking service, which consumes 58 per cent of the divisional output per year. There has been a limited local outlet to the paper mills for low-priced secondary hydro-electric energy when available at the division's generating plant, at such times as paper-mill operations permitted utilizing this service.

The St. Johnsbury division has five low-head hydro-electric plants, with an installed capacity of 1,427 kw.,

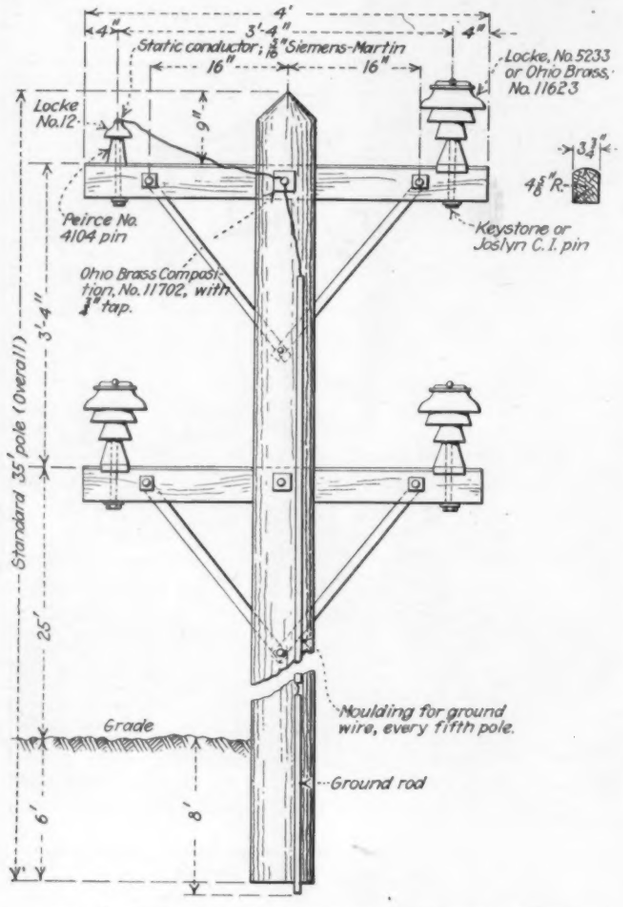


FIG. 4—DETAILS OF POLE-TOP CONSTRUCTION, WHITE MOUNTAIN TIE LINE

on the Passumpsic River. This stream falls about 150 ft. in 22 miles in the vicinity of St. Johnsbury, and station runner capacity is available to utilize river flows with the exception of those available for about 18 per cent of the normal year. The prime flow of the stream, with full utilization of the limited pondage

TABLE I—ESTIMATE OF CONSTRUCTION COST OF ADDITION TO STEAM PLANT

800 ft. standard-gage railroad track	$2,000.00
Additional coal storage, including concrete dump pocket, incline and retaining wall, 100 yd.	1,800.00
Boiler-plant building addition, concrete footings and pilasters, brick panels, tile tar and gravel roof to match present structure, 25 ft. x 35 ft. x 30 ft. high	3,500.00
Generator-room building addition, construction similar to above, including removal of existing west wall, 10 ft. x 34 ft. x 18 ft.	1,375.00
Two 300-hp. B. & W. water-tube boilers, hung on steel, including settings, grates and fittings	18,000.00
Boiler-room piping, stack breeching, feed-water heater, feed-water pump	7,500.00
Clearing floor area, excavation for generator and condenser foundations, 100 yd.	800.00
Foundation, 50 yd.	900.00
750-kw. steam turbo-generator unit, erected complete with switchboard and electrical connections	26,000.00
1,500 sq.ft. surface condenser, complete with auxiliaries and erected	19,000.00
Generator-room steam and water piping, air ducts, etc.	4,000.00
Steel stack with foundations and flue connections erected	8,000.00
Sub-total	$92,875.00
Interest during construction	4,643.00
Engineering, 3 per cent	2,786.00
Office expense (construction), 2 per cent	1,857.00
Casualty insurance, contractors' bond, etc.	5,805.00
Contractors' profit, 15 per cent on items suitable for contract only	4,783.00
Total estimate	$112,749.00

TABLE II—ESTIMATED CONSTRUCTION COST OF TIE LINE AND SUBSTATIONS

St. Johnsbury No. 2 station, substation, wooden-pole and timber structure with knife-blade disconnecting switches, choke coils and concrete foundations	$2,000.00
Three 500-kva., 2,300/33,000-volt oil-insulated, self-cooled, outdoor-type transformers with four 2½ per cent taps	7,125.00
33,000-volt, three-phase outdoor-type oxide-film lightning arrester	1,350.00
52 miles of transmission line, 35-ft., 7 in. top, Northern white cedar or chestnut poles, space 200 ft. to 250 ft. apart, No. 2 copper, Locke 5233 or Ohio Brass 11623 porcelain insulators:	
1,300 poles, framed and delivered to place, at an average cost of $12 each	15,600.00
3,900 insulators, at $2.50 each	9,750.00
2,600 cross-arms, at $1 each	2,600.00
3,900 Keystone galvanized pins	3,120.00
300 spring-thread galvanized ground-wire pins	650.00
1,300 O.B. 9403 or Locke 4451 insulators	260.00
Two 33,000-volt, three-phase outdoor-type oxide-film lightning arresters, en route, with concrete foundations, wooden pole and timber structure, TD-227 disconnecting-type expulsion fuses, protective fence	5,000.00
1,300 sets pole hardware, exclusive of pins	2,600.00
650 anchors and guys, complete at $5 each	3,250.00
159,000 lb. of No. 2 medium-hard-drawn bare copper wire at 16½ cents delivered	26,250.00
55,000 lb. of 7/16-in. galvanized-iron strand	3,750.00
260 ground rods and connections at $4	1,040.00
1,300 telephone-line cross-arms, complete with hardware, pins and insulators at $2.50 each	3,250.00
31,400 lb. of No. 9 iron telephone wire	2,200.00
Two telephone sets, insulating transformers and protective apparatus, drainage coils, etc.	400.00
Gorham substation wooden-pole and timber structure with knife-blade disconnecting switches, choke coils and concrete foundations	2,250.00
Two 750-kva., 2,300/33,000-volt outdoor-type, T-connected, two- to three-phase transformers with 4 2½ per cent taps on high-tension winding	7,125.00
33,000-volt, three-phase, oxide-film lightning arrester	1,350.00
Labor of erecting, 50 miles, at $425 per mile	21,250.00
Right-of-way, including salary and expenses right-of-way agent and clearing right-of-way of growth, 50 miles, at $400 per mile	20,000.00
Sub-total	$139,795.00
Engineering, 3 per cent (exclusive of right-of-way)	3,595.00
Interest during construction	6,990.00
Office expense (construction), 2 per cent	2,796.00
Casualty insurance	6,375.00
Contractors' profit, 10 per cent (exclusive of right-of-way)	11,980.00
Total estimate	$171,531.00

TABLE III—SUMMARIZED TOTAL COSTS OF STEAM-PLANT EXTENSION AND TRANSMISSION TIE LINE

Operating Assumptions Made for Computation of Production Costs

Year	Steam Peak, Kw.	Steam Output, Kw.-hr.	Annual Load Factor, Per Cent	Steam Fuel per Kw.-hr. (Lb.)	Price of Coal	Total Cost of Fuel	Steam Plant Labor	General Steam Station Expense	Steam Operating Expense	Total Steam Expense, Operating Plus Fixed Charges	Total Steam Production Cost per Kw.-hr. (Cents)
1922	950	1,500,000	18	5.25	$9.25	$36,400	$7,200	$3,600	$47,200	$79,447.00	5.3
1923	1,100	1,700,000	18	5	8.75	37,200	8,600	4,200	50,000	82,247.00	4.8
1924	1,300	2,000,000	18	4.75	8.25	39,200	9,800	4,800	53,800	86,047.00	4.3

Computation of Delivered Cost of Energy at St. Johnsbury for Hydro-Energy Interchanged

Year	Gross Delivery from Gorham to St. Johnsbury, Kw.-hr.	Energy Charge at 1½ Cents per Kw.-hr. Deliv ered	Annual Fixed Charges on Investment Present St. Johnsbury Steam Station	Annual Fixed Charges on Apportioned Vermont Investment in Trans-mission Line	Total Gross Cost of Energy to St. Johnsbury	Gross Cost per Kw.-hr. to St. Johnsbury (Cents)	Gross Return, Kw.-hr. from St. Johnsbury to Gorham	Gross Receipts to St. Johnsbury for Return Energy at 0.27 Cent per Kw.-hr. at St. Johnsbury Switchboard	Net Cost of Energy to St. Johnsbury	Net Cost of Energy to St. Johnsbury per Kw.-hr. (Cents)
1922	1,500,000	$22,500	$11,100	$8,060.00	$41,660	2.76	600,000	$1,620	$40,040	2.67
1923	1,700,000	25,500	11,100	8,060.00	44,660	2.63	600,000	1,620	43,040	2.53
1924	2,000,000	30,000	11,100	8,060.00	49,160	2.46	600,000	1,620	47,540	2.38

available, when applied to the local system load factor, is capable of generating about 300 kw. At one of the hydro-electric stations near the division load center a 625-kva. horizontal steam-turbine unit is installed as an auxiliary. Fig. 1 shows spring and winter load curves for this division, the power load being below normal on both dates shown. The annual peak is a day power peak about double the winter night lighting peak.

Energy for the Berlin district is provided by a 1,280-kw. hydro-electric station at Gorham, utilizing a 14-ft. head on the Androscoggin River. The Androscoggin, one of the best-regulated streams in New England, has a prime flow of about 1,500 cu.ft. per second, and 2,500 foot-seconds is available for about 40 per cent of the normal water year. The Gorham station is now being modernized, by substitution of more efficient units and dredging of the tailrace, to an ultimate development of 3,000 kw. installed capacity, under which condition it will produce about 300 per cent additional kilowatt-hours per year.

Spring and winter load curves for the Berlin district are shown in Fig. 2. On these dates the water conditions were such that the mills were not taking secondary energy. The annual peak in this district is the night lighting peak in winter.

An analysis of operations in the two districts for several years past and a forecast of future load growth revealed that through diversity in load between the Berlin and St. Johnsbury areas the delivery of secondary surplus hydro-electric energy from the Gorham station would end steam operation at St. Johnsbury. This study also showed that from the combined stations approximately the same amount of secondary hydro-electric energy would be available for sale to the paper industry in upper New Hampshire as had obtained in the past. The Berlin district had no steam station auxiliary to its hydro-electric plant. The construction of the transmission line made available to the New Hampshire district the existing steam auxiliary in the Vermont district. Tables I and II show the estimated comparative costs of adding a 750-kw. steam-turbine unit with boiler plant and auxiliary equipment to the St. Johnsbury station and of building a 52-mile

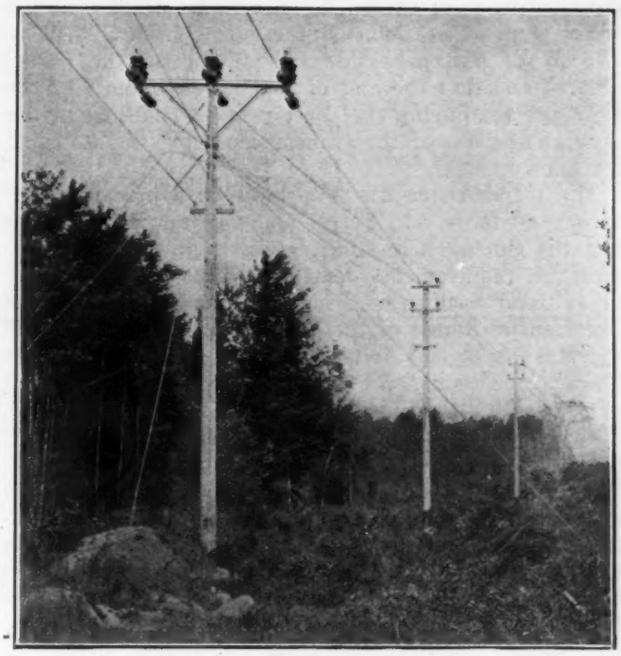


FIG. 5—LINE-SECTIONALIZING STATION AND TYPICAL SECTION OF LINE

transmission tie line between the two divisions with the necessary substations and auxiliary equipment. The first cost reached in the former case was $112,749 and that reached in the latter case was $171,531.

The balance sheet between the two methods is shown in Table III, which summarizes the over-all cost of energy at the St. Johnsbury plant buses, allowing for fixed charges on each scheme and taking into account the revenue derived from the estimated sale of energy from St. Johnsbury to the Berlin division. Fixed charges assumed totaled 18.5 per cent. The estimate covered the anticipated growth of loads from 1922 to 1924 inclusive and led to the conclusion that by building the transmission line the cost of energy including fixed charges would be 2.38 cents net per kilowatt-hour at St. Johnsbury in 1924 compared with 4.3 cents if the

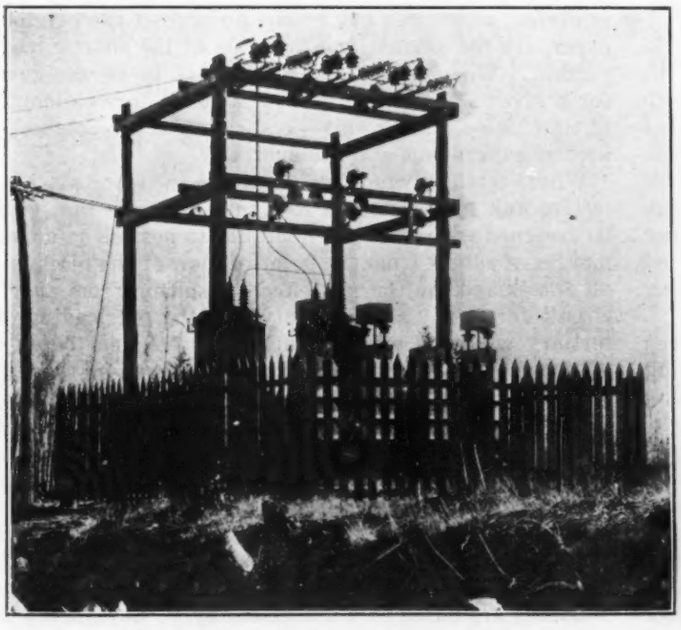


FIG. 6—OUTDOOR SUBSTATION AT GORHAM

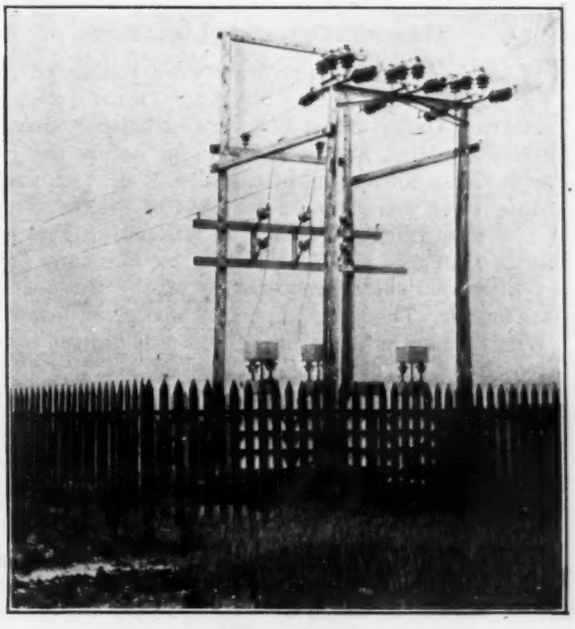


FIG. 7—LIGHTNING-ARRESTER STATION

steam plant were extended. It will be noted that the steam plant at St. Johnsbury requires from 5.25 lb. to 4.75 lb. of coal per kilowatt-hour during the period covered and that the cost of coal ranges from $9.25 to $8.25 per ton during the three years. The final saving through the use of the transmission line is 1.92 cents per kilowatt-hour.

The transmission line was built on a private right-of-way 60 ft. wide. Patrol and maintenance features dictated general accessibility from highways, and construction requirements demanded reasonable proximity to railroad facilities. The line passes through the Presidential Range of the White Mountains. The line operates at 33,000 volts, and the poles are class B Western red cedars, 35 ft. long, with a maximum span of 250 ft., pin-type insulators and No. 2 medium hard-drawn copper. A typical section of the line is shown in Fig. 5 and details of pole top and fixtures in Fig. 4. Wooden-pole substation structures installed at Gorham and St. Johnsbury are shown in Figs. 3 and 6 respectively. The high-tension fittings were furnished by the Railway & Industrial Engineering Company, Greensburg, Pa.; the insulators are Locke No. 5233's, and the transformers and lightning arresters were supplied by the General Electric Company. A typical lightning-arrester installation is shown in Fig. 7. This is also a line-sectionalizing station, one arrester being provided at the end of each 17-mile section of the line. No high-tension oil circuit-breakers were used. A private telephone line connecting the generating stations is installed below the transmission line on the same poles.

The line was placed in operation in the summer of 1922. It was built under contract at a total cost, including right-of-way and substations, of $165,000, or about 3.5 per cent less than the estimated cost. The actual operating economies of the interconnection will probably somewhat exceed those of the estimate.

Use of Auto-Transformers with Tertiary Windings

Three Windings Result in Economy—Determination of Rating of Tertiary Winding—Test Precautions and Operating Limitations

MANY interesting problems were concerned in the paper "Performance of Auto-Transformers with Tertiaries Under Short-Circuit Conditions" presented by Messrs. Mini, Moore and Wilkins before the recent Pacific Coast convention of the A. I. E. E. An abstract of this paper was given on page 864 of the Oct. 27 issue of the ELECTRICAL WORLD. In discussing this paper Clinton Blume of the General Electric Company pointed out a few salient characteristics of the three-winding transformer. The more important are given below:

Wherever transformation of power is desired between three circuits of different voltages the practice of using three windings is growing, on account of the resulting economy, not only in first cost, but also in operation.

By using one transformer bank rather than two, double transformation of power is avoided and the total amount of transformer kva. for a given service is correspondingly reduced. A particularly interesting and important illustration is in high-voltage transmission where synchronous condensers are used for power-factor control, in which case the synchronous condenser sometimes is neutralizing the lagging reactive current of the low-voltage system and at other times is neutralizing the leading charging current of the high-voltage line. The joining together in one bank of the transmission line, the low-voltage circuit and the synchronous condenser for the purpose of transforming directly from any one circuit to any other by one transformation is the unique function of the three-winding transformer.

CORRECTIVE FEATURES OF TERTIARY WINDINGS

In addition to this, however, it is also being frequently used where the Y-Y connection is primarily desired, the third winding being added merely to correct the inherent weakness of the Y-Y connection. These weaknesses, resulting sometimes in abnormal voltages either in the connection or in the line, or sometimes in interference with parallel telephone lines and also in various operating difficulties, may be grouped under the rather broad generalization of neutral instability. This use of the tertiary delta is in itself a good evidence of its superiority over the Y-delta connection, for by the addition of the delta the stable characteristics of the Y-delta connection are obtained. It is desirable to point out in this connection that if the tertiary winding is not needed for loading purposes the Y-delta connection is simpler and cheaper, and therefore the only legitimate reason for adding the third winding is found in those cases where the system conditions are such that a Y connection for both the primary and secondary windings is essential. Thus it is seen that the three-winding transformer is being employed for two distinct reasons —economy both in first cost and operation and securing specific improvements in operating characteristics.

However, whatever may be the reason for the use of the three windings, the majority of them are connected in Y-Y-delta, with the delta tertiary having a capacity considerably less than the rating of the main windings. In these cases the size of the tertiary winding may not be determined by the load which it is to deliver, but rather by other characteristics such as the short-circuit current. For example, a short circuit from line to neutral on either the high-voltage or low-voltage circuit results in a short-circuit current circulating in the delta, limited only by the internal reactance of the tertiary winding. In this case the controlling factors in design, as pointed out by the authors of the original paper, are the amount and duration of the short-circuit current. When a tertiary winding is to be designed for a given short-circuit current and for a given length of time, these other terms—kva. rating and reactance—become superfluous and are arbitrary.

Where tertiary windings constitute an important protective link in a system it is highly desirable that they be designed with sufficient liberality to possess an ample margin of safety from the point of view of the mechanical forces and the thermal effects resulting from short-circuit currents. The certainty that the overloading of tertiary windings will be much more frequent because of short circuits and also of longer duration than in ordinary transformer windings is an additional reason for a conservative policy. Moreover, in most instances a larger tertiary costs comparatively little more than a small tertiary. For example, comparing a tertiary winding of 50 per cent capacity with one of 25 per cent capacity, the former involves only 5 per cent or 6 per cent increase in transformer cost. The various arguments for conservative practice in the design of tertiary windings are based on a discussion by A. Boyajian, who has treated the subject in considerable detail.

To determine the short-circuit current and regulation performance of a three-winding transformer it is essential to have a clear conception of the manner in which the reactance between the windings affects the current division, regulation and short-circuit currents. The determination of these characteristics may prove to be very perplexing and unnecessarily complicated unless the fundamental relations are clearly understood. These relations, however, are fortunately quite simple.

In a two-winding transformer the internal impedance is usually expressed in terms of one reactance—the leakage reactance between primary and secondary—and the resistances of the two windings are lumped into one, and thus one value of impedance is sufficient to express the voltage consumed internally by the transformer. From time to time academic discussions arise concerning how much of the reactance belongs to the primary and how much to the secondary, but no practical use is served in attempting to make this distinction, and no matter how the reactance is assumed to be divided between high-voltage and low-voltage windings, the performance of the transformer remains unchanged. Therefore it is common practice to use only one value to express the impedance of a two-winding transformer, and the reason that this may be done is because the high-voltage and low-voltage currents are equivalent and in phase.

On the other hand, in three-winding transformers the current flowing in one winding is not necessarily equivalent to or in phase with a current in one of the other windings, and for that reason resistances and reactances cannot be so simply expressed. It is convenient, and in fact necessary, to consider that every winding possesses a reactance belonging to itself just as distinctly as its resistance, and that they are connected together in the equivalent circuit in Y. Having segregated in this manner the impedance into a primary, a secondary and a tertiary value, regulation drop can be calculated for each one separately by using the ordinary formula for regulation. Thus there are two new problems introduced by the three-winding transformer. First, the determination of the size of the tertiary winding may not be obtained in the ordinary manner, but by one or more of the unique functions which it is called upon to perform; second, the three windings are so related to each other that impedance and regulation cannot be so simply expressed as in ordinary transformers, although by means of a simple equivalent circuit equivalent impedance values can be determined for each winding and these values used in the ordinary formulas to obtain regulation or current division for any given condition. Aside from the above features, three-winding transformers are not in any way different from the ordinary transformers.

Lightning-Arrester Grounds—I

Characteristics of Pipe Grounds—Resistance of Grounds—Artificial Treatment of Soils—Maintenance, Installation and Testing of Grounds—Ground Connections for Different Service Conditions

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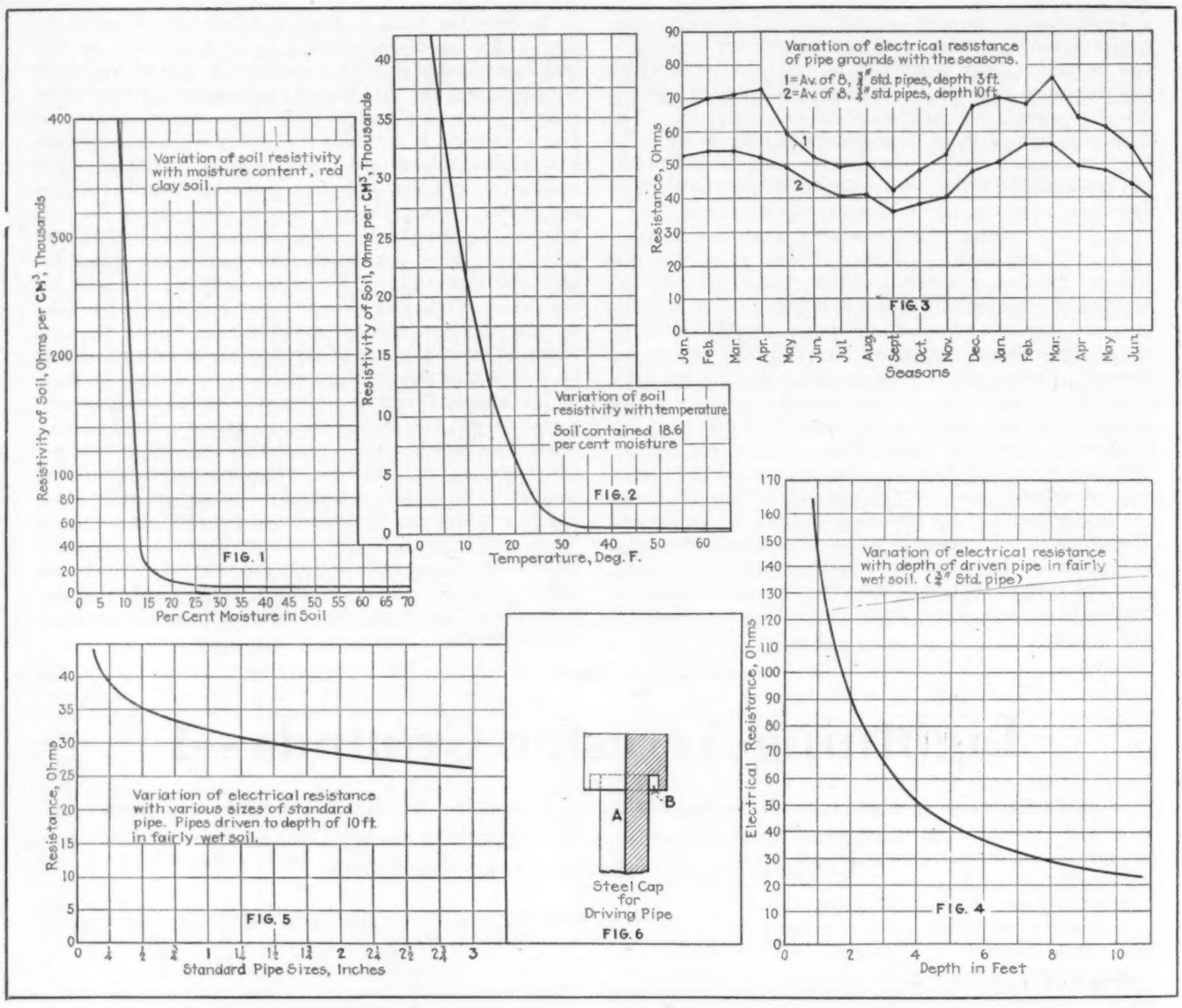
STANDARD practice in overvoltage protection lies essentially in the use of lightning arresters which are connected between the electric circuit and earth, thus forming a path of discharge to earth for voltages which would overstress apparatus insulation. But a lightning arrester is no better than the ground connection by which it is earthed, and even the most modern and approved arresters become worthless in their protective value when installed with unreliable high-resistance earth connections.

While driven pipes are not the established standard method of grounding arresters, it can be said that they possess many advantages over other methods which have been used, such as buried plates, buried strips, coils of wire and the various patented ground electrodes commonly advertised. Chief among the advantages is the low cost of the pipes as compared with the other forms of ground electrodes and the simplicity of driving a pipe compared with the task of excavating for and installing the buried form of ground electrodes. Moreover, the ground area required by a driven pipe is small, a decided advantage in some places where excavation is out of the question because of restricted space or pavements. Another noteworthy advantage is that the connection between the ground wire and the driven pipe can be made above the surface of the ground, which counts for easy inspection and testing and eliminates the possibility of a defect being obscure, such as a ground wire broken below the ground surface by corrosion or by mechanical thrusts and shifting caused by frost. An analysis of the electrical resistance to earth formed by the different types of grounds shows that the driven pipe compares very favorably with any of its competitors, but it has the outstanding advantage that two or more pipes may be driven and connected in parallel at a cost usually less than that of one of the buried types of grounds, and thus it is possible to obtain a very much lower ground resistance with driven pipes than with the other types for a given cost. Where permanent moisture is at a considerable depth in soil, the driven pipe has an obvious advantage, being capable of reaching depths of 20 ft. or more where the soil is of friable texture. From the standpoint of maintenance and artificial treatment the driven pipe continues to hold its superior rating.

Copper-clad steel ground rods have been used in a few cases and in general have the same characteristics as the pipe, but have the additional advantages of resisting corrosion over a somewhat longer period, and they also enable a simple soldered connection to the copper ground wire. Their cost, however, is consider-

*Paper presented before the Southeastern Division of N. E. L. A., Tampa, Fla., Nov. 20, 1923.


Variation of soil resistivity with moisture content, red clay soil.
Resistivity of Soil, Ohms per CM³, Thousands
Per Cent Moisture in Soil
FIG. 1
Variation of soil resistivity with temperature. Soil contained 18.6 per cent moisture
Resistivity of Soil, Ohms per CM³, Thousands
Temperature, Deg. F.
FIG. 2
Variation of electrical resistance of pipe grounds with the seasons.
1=Av. of 8, ¾" std. pipes, depth 3 ft.
2=Av. of 8, ¾" std. pipes, depth 10 ft.
Resistance, Ohms
Seasons
FIG. 3
Variation of electrical resistance with various sizes of standard pipe. Pipes driven to depth of 10 ft. in fairly wet soil.
Resistance, Ohms
Standard Pipe Sizes, Inches
FIG. 5
A
B
Steel Cap for Driving Pipe
FIG. 6
Variation of electrical resistance with depth of driven pipe in fairly wet soil. (¾" Std. pipe)
Electrical Resistance, Ohms
Depth in Feet
FIG. 4

Variation in Resistance of Grounds Depends on Many Elements, Such as Moisture, Temperature, Depth and Size of Pipes

Fig. 1—Effect of moisture in soils.

It is of great importance that the effect of moisture in soils be fully appreciated. This curve is plotted from experimental data taken on a sample of red-clay soil and may be regarded as more or less representative of most soils. The moisture content is expressed in per cent by weight of the dry soil. Dry earth weighs about 90 lb. per cubic foot, and thus 10 per cent moisture content means the ratio of 9 lb. of water per cubic foot of dry soil. It will be seen that above 22 per cent moisture the resistivity is but little affected, while below 22 per cent the resistivity increases very abruptly with decrease in moisture content. A difference of a few per cent in moisture will therefore make a very marked difference in the effectiveness of a ground connection made with electrode of limited extent, especially at moisture content below 22 per cent. Hence, wherever there is a choice in the matter, locations for arresters and ground connections should be where the greatest amount of moisture is to be obtained. The normal moisture content of soils ranges from 10 per cent in dry seasons to 35 per cent in wet seasons, but an approximate average may be perhaps 16 to 18 per cent.

Fig. 2—Effect of temperature in soils.

The temperature coefficient of resistivity for soil is negative, but is of quite negligible account for temperatures above freezing, that is, above 32 deg. F. Below this temperature the water in the soil begins to freeze and introduces a tremendous increase in the temperature coefficient, so that as the temperature becomes lower the resistivity rises enormously. The curve shows the effect of temperature and is plotted from experimental data taken on clay soil having 18.6 per cent moisture content. For different soils the curve will not, of course, be strictly correct, but the order of magnitude should remain about the same, and therefore a ground electrode which is intended to be operative throughout the year must be installed well below the frost line. Where winter seasons are severe this may be 6 ft. or 7 ft. below the surface, whereas in mild climates the frost may penetrate only a few inches or perhaps the ground may not freeze at all. Ground pipes which are not driven below the frost depth will have a very great variation in resistance throughout the seasons of the year. Even when driven below the frost line, there is some variation, since the upper soil when frozen presents a decided increase in soil resistivity and has the effect of shortening the active length of pipe in contact with soil of normal resistivity. It must be remembered that lightning arresters must function during the winter months to discharge the static charges which accumulate on the line from snow and sleet storms and also to discharge the overvoltage surges originating from switching, load changes, arcing grounds, etc., and so the importance of low-resistance ground connection for arresters must not be associated entirely with the summer lightning seasons.

Fig. 3—Effect of seasonal variation on soil resistance.

The curve shows the seasonal variation in resistance of two pipes driven to depths of 3 ft. and 10 ft. in rather stony clay soil. The data for these curves were obtained experimentally near Washington, D. C., and there were no extremely cold periods, little freezing weather and no extremely dry periods. Despite the very temperate weather, however, it will be seen that the maximum resistance of the 3-ft. pipe is 1.81 times its minimum resistance, while the pipe driven to a 10-ft. depth has a maximum resistance of 1.56 times its minimum. In both cases the maximum resistance occurred during February and March and the minimum values about the last of August. The average values for the year will in most cases obtain about the last of April and the last of November. Obviously, these curves cannot be taken to indicate the magnitude of change that might be expected for any locality, since the seasonal variation will be different for various soils and for different climatic conditions, and, in fact, the variations may differ widely from year to year in the same locality.

Fig. 4—Variation of resistance with depth of a driven ¾-in. standard pipe.

Fig. 5—Variation of resistance of driven pipes of various standard sizes.

Fig. 6—Steel cap to cover top of pipe.

ably more than even the extra-heavy galvanized pipe for a given diameter. There has apparently not been enough experience with the copper-clad steel rods in actual service to say definitely whither their extra expense is justified by added life. Considered on the same cost basis as the standard iron pipes, the copper-clad rods would be entitled to favor.

Components of Ground Resistance

In considering any form of lightning-arrester ground connection the total electric resistance to the flow of current away from the arrester to earth can be divided into four parts—first, the part contributed by the ground wire and its connections to the ground electrode and the arrester it is designed to serve; second, the part contributed by the ground electrode itself; third, the part contributed by imperfect and limited contact between the ground electrode and the soil; fourth, the part contributed by the soil. It is the combination of all which produces the net result.

The resistance of the ground wire is usually quite negligible in comparison with the total resistance, particularly when a reasonably large cross-section of good conductor is used. The National Electrical Code stipulates that a lightning-arrester ground wire shall not be smaller than a No. 6 B. & S., which is of 0.162-in. diameter bare. The size, however, depends to some extent upon the character of the circuit it is connected with, since the maximum induced static charge or overvoltage on any electrical circuit is limited largely by the line insulators and the discharge current is roughly 2.2 amp. per kilovolt. It follows, then, that the average discharge current through an arrester ground wire from a low-voltage distribution circuit will not be nearly as great as in the case of a high-voltage transmission line. Furthermore, the distribution circuit has arresters at each transformer location, so that for any area affected by induced lightning or overvoltage there are a number of discharge paths in multiple, and thus the individual discharge path does not need to be of such low resistance as in the case of a transmission line where the total energy of the overvoltage must be discharged through one or possibly two arrester ground wires. Therefore, while the No. 6 ground wire would be entirely suitable for arresters on the lower-voltage systems, such as ordinary 2,300-volt distribution, it is desirable to increase the size for the higher-voltage arresters. A No. 2 B. & S. ground wire (0.256-in. diameter) is a preferable size for the more important or isolated arrester installations on circuits such as 6,600, 11,000 and 13,200-volt distribution. For the larger arresters on transmission systems the No. 2/0 (0.364-in. diameter) or No. 4/0 (0.46-in. diameter) ground wires, or their equivalent, should be employed.

The ground wire possesses the only appreciable inductive component between the arrester and earth, and attention to the size of the ground wire is only a step toward minimizing the inductive component. The important considerations are the avoidance of unnecessary length and tortuous circuit. This requires the arrester to be as near the ground as possible, and the ground electrodes must be installed at the immediate arrester location. Attention to the inductive component of a ground wire is not generally necessary when installing safety grounds such as for neutrals or for electrical machine frames, but for the lightning discharge path inductance is a major factor in preventing freedom of discharge for the transient overvoltage energy. An arrester ground wire 50 ft. or more in length and made tortuous by the introduction of several angular bends will impose serious penalties in the way of reduced protection.

TABLE I—MEASUREMENT OF GROUND RESISTANCE BY THE BUREAU OF STANDARDS

Number of Grounds Tested		Average Resistance	Minimum Resistance	Maximum Resistance
24	Fills, and ground containing more or less refuse such as ashes, cinders and brine waste	14	3.5	41
205	Clay, shale, adobe, gumbo loam and slightly sandy loam with no stones or gravel	24	2.0	98
237	Clay, adobe, gumbo and loam mixed with varying proportions of sand, gravel and stones	93	6.0	800
72	Gravel, sand or stones with little or no clay or loam	554	35	2,700

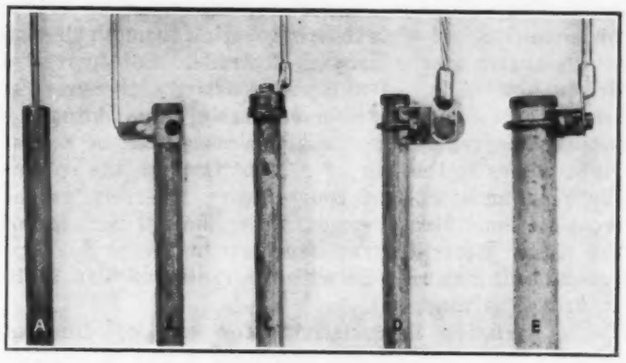


FIG. 7—FIVE METHODS OF CONNECTING THE GROUND WIRE TO THE PIPE

In A the ground wire is soldered inside of the pipe. This is done by first driving a wooden plug snugly into the pipe for a distance of 3 in. or 4 in. below the top, the ground wire being then inserted into the space above the plug and the remaining space filled with melted lead or solder, using a good chloride flux. The inside of the pipe must be very clean to insure fusion with the solder, and in this particular connection the galvanized pipe has obvious advantage. A mixture of antimony and lead, in 25 per cent and 75 per cent proportion respectively, forms an alloy which may be very effectively used instead of solder. It is poured around the ground wire in a molten state, and on cooling the metal expands and forms a junction which is not only very rigid but of satisfactory low resistance. The use of a chloride flux is desirable to insure an adhesive bond.

B shows a punched-tube copper terminal securely bolted to a pipe and the ground wire soldered in the terminal. A punched pipe cap over the top of the pipe improves the appearance.

C is an ordinary iron pipe cap screwed on the pipe and a copper terminal bolted to a tapped hole in the cap. This scheme is somewhat similar to the ground cap and has the disadvantage of requiring the thread on the pipe.

Methods D and E require a simple U-bolt fitting or clamp. The former uses a T clevis U-bolt clamp, and the ground wire terminal is securely bolted to the clevis. The fitting shown in E is commonly used in mounting panels to pipe work and has a threaded lug to which the ground wire terminal may be bolted. The contact surfaces of the pipe and clamp should be filed clean and bright before attaching with the U-bolt. In all cases where the copper terminal is bolted to an iron fitting or to the pipe itself care should be taken to get a relatively large contact area between the copper and the iron to avoid possible localized galvanic action affecting a resistance contact. If copper-clad-steel ground rods are used instead of pipe, another simple form of connection is to lash the ground wire to the top of the rod with a flexible bare copper wire about No. 16 B. & S. and then pour on molten solder, using flux freely so that any space inside the wire lashing is entirely filled with solder.

The extreme high-frequency wave fronts and oscillations attending lightning phenomena cause a pronounced skin effect in conductors, thus inviting favor to ground wires having large surface area for a given conductivity, and copper strip or tubing presents some advantage in this respect. The use of iron ground wires is not recommended, since the skin effect introduces a much greater increase in the effective impedance than in the case of copper wire.

The resistance of the ground electrode itself is in nearly all cases an entirely negligible part of the total resistance of a ground connection. The resistance introduced by contact between the ground electrode and

the soil is also generally negligible for those metals commonly employed for ground connections, and particularly if the metal is clean and the soil is firmly pressed around the electrode. Electrodes used, however, are not always clean and may be often covered with paint or grease, which will increase the contact resistance appreciably. Rust on the surface of a ground electrode is of little or no account in increasing contact resistance, since rust is iron oxide (Fe_2O_3), which is permeable to water and is of no greater resistivity than soils.

The part of the total resistance which is contributed by the soil is the most important part of a ground connection. This resistance is made up of all of the multiple paths of variable cross-section through the soil which surround the ground electrode. Considering a driven pipe in soil of uniform resistivity, the greatest resistance is in the soil immediately surrounding the pipe in the region of smallest cross-section of soil at right angles to the flow of current through the soil, as the resistance will, of course, vary inversely as the cross-section. Measurements show that 90 per cent of the total electrical resistance surrounding a pipe ground will generally lie within a radius of 6 ft. to 10 ft. from the pipe.

The variation in resistivity for soils of different textures and compositions which are found in practice is from a few hundred ohms to a million ohms or more per cubic centimeter and depends upon the particular ingredients of the soil, the amount of moisture in the soil and the temperature of the soil. The electrical conductance of any soil is by means of the electrolytes formed by moisture combining with the soluble acids, alkalis and salts, and thus the specific resistance depends very largely upon the kind of chemicals and amount of moisture in the soil. In a salt marsh the resistivity is extremely low, being but a few ohms, while in a dry sand bank the resistivity approaches infinity. The numerous kinds of soils prevent a simple classification, and generally three or more kinds of soil are involved for any one driven pipe. The surface soil is usually dry and more or less non-conducting; below this is a stratum of semi-moist soil of different texture, and finally at some lower level is a stratum of soil which is more or less saturated with moisture. The average soil resistivity for soils throughout the country is probably between 2,000 ohms and 10,000 ohms per centimeter cube.

EFFECT OF DEPTH

The depth to which a pipe is driven is the most important factor affecting its electrical resistance. There are three reasons for this—first, the area of contact between the pipe and soil increases directly with the length of the pipe below the ground surface; second, the soil resistivity decreases with depth by virtue of the increased moisture content; third, the change of resistance of a pipe ground as affected by freezing temperatures becomes less with increased depth. Fig. 4 is a curve showing the variation of resistance with depth of a driven ¾-in. standard pipe. This curve was plotted from calculated data assuming soil of uniform resistivity at all depths, and it has been checked experimentally with only small irregularities. As stated previously, however, the soil is seldom of uniform resistivity throughout the different depths, and so, practically, the curve shows only what depth in conducting soil it is most desirable to reach. It will be seen that there would be only a small percentage decrease in resistance for each additional foot greater than 10 ft. Assuming that permanent moisture in the soil is reached at this depth, we may say that 10 ft. would be the economical limit for depth. In many localities even this depth will be out of the question owing to inpenetrable coarse stones or rock being encountered. The depth in practice will depend, therefore, somewhat on the local topography at the actual point of installation, but where at all possible at least 6-ft. depth should be attained. With less than this depth the number of pipes in parallel must be increased and artificial treatment of soil becomes more important.

The size of pipe which should be used in making lightning-arrester grounds depends largely upon the mechanical considerations. A size that will stand the mechanical strains attending the driving operation will in most cases be suitable electrically. Fig. 5 shows the variation of electrical resistance of driven pipes of various standard sizes driven to a depth of 10 ft. In the exceptional cases where depths greater than 10 ft. are necessary to strike permanent moisture the 1¼-in. or 1½-in. sizes are a preferable choice. For average conditions of soil and for depths up to 10 ft. the 1-in. standard pipe will be found very satisfactory and is relatively inexpensive.

The relation of pipe diameter to resistance of a driven pipe will hold true also to steel or copper-clad steel ground rods. However, these, being solid, will possess more mechanical strength than the pipe for a given outside diameter, and it would seemingly be seldom if ever necessary to use a solid rod of more than 1¼-in. diameter. For ordinary soil conditions a ⅝-in. diameter rod is satisfactory.

SUGGESTIONS ON DRIVING

Where soil is of such coarse, stony texture as to make pipe driving very difficult, time and material may often be saved by first penetrating the ground with a steel bar with tempered point and having a diameter somewhat less than that of the pipe. The bar will stand almost unlimited hammering, and when it is removed the pipe can be driven into the hole with comparative ease. If the bar is larger than the pipe, the resulting contact between the pipe and soil will not be good, and considerable time will be required for the soil to settle down to form a pressure contact with the pipe. When the bar is used some means must be provided to remove it quickly from the driven position, and for this operation a lever of proper dimensions to give a 3-ton or 4-ton force exerted on the pipe, or a lifting jack similar to what is used on the circus grounds for pulling the tent stakes, will serve the purpose.

If the pipe is driven, it is desirable to use a steel cap over the top of the pipe to prevent battering the pipe. Such a cap is shown in Fig. 6. The shank *A* is made to fit closely into the inside of the pipe to be driven and should extend into the pipe about 6 in. or 8 in. The top end of the pipe fits into the groove *B* of the cap, the groove being slightly wider than the thickness of the wall of the pipe, and about ½ in. deep. A great many pipes may be driven before the cap will need to be renewed. A pipe may be driven with either square or flattened end to penetrate the soil, and there is not generally sufficient advantage with the flattened end to warrant the labor expended in the flattening operation. So-called "ground points" may be purchased from electric power equipment dealers which are tem-

pered and have a shank that fits inside the pipe. These simplify driving somewhat, but not generally in sufficient degree to warrant their cost.

The connection between the ground wire and the pipe may be provided for by fittings or so-called "ground caps." The latter require a thread on the upper end of the pipe and the cap screws on this thread and provides a lug into which the ground wire may be soldered. The disadvantage of this method, however, lies in the necessity of threading the pipe, which must be done after it is driven to avoid injuring.

Long life of the ground connection is very desirable, and to this end the construction of connections to the ground electrode should be made very substantial. The materials used should not present excessive electrochemical actions or galvanic couples at the joints. The contact difference of potential of iron to lead or ordinary solder is about 0.41 volt, the iron being negative. The difference between lead and copper is 0.56 volt, the copper being negative, while iron is 0.15 volt positive against copper. One of the worst combinations is copper against zinc, which is quite commonly had when galvanized iron is in contact with copper. Copper is negative 0.71 volt against zinc. However, neither of these conditions is very serious unless combined with some electrolyte. Zinc-coated fittings for line construction materials have been used for years in contact with copper without any great amount of trouble. The greatest danger in ground connections is when the contact between the different metals is under the surface of the ground and electrolytes in the soil may promote electrochemical action. It is therefore good practice to coat the joints between the different metals with tar, pitch or paint. This will reduce corrosion.

The second and final chapter of Mr. Towne's article will be published in next week's issue.

Straight-Line Graph for Computing Tensions in Line Conductors

Rearrangement of Older Formula to Obtain a Straight-Line Diagram Which Will Readily Give the Proper Tension to Use, Considering Temperature and Loading

By E. S. THAYER
Seattle, Wash.

THE following method for deriving the conductor tension for any condition of loading and temperature is proposed as being simple and easily applied and a possible improvement over existing methods in that straight and parallel lines are substituted for one set of curves.

The familiar sag-tension chart (Fig. 1) requires that one curve be plotted for each temperature and length of span and one for each loading and length of span, their intersection giving the conductor tension to be found. In the method described below the temperature lines are straight and parallel (Fig. 2) and may be quickly drawn with two triangles, thereby practically cutting in half the time required for a complete solution. The equation used is

$$Bt + 1{,}000(T - T_o) = KL^2[(1/T^2) - R] \quad (1)$$

in which

$B = aMA$ (in which a = temperature coefficient of expansion per degree F., M = modulus of elasticity, A = area of cross-section in square inches).

t = temperature rise in degrees F.

T = tension sought, in thousands of pounds.

T_o = tension under known conditions, in thousands of pounds.

$K = W^2MA/24$, in which W is the weight per foot corresponding to T.

L = length of span in thousands of feet.

$R = (W_o/WT_o)^2$, in which W_o is the weight per foot corresponding to T_o.

The value of T satisfying equation (1) will be the tension sought. Since this is a cubic equation, its solution algebraically is too laborious to be practicable, and the graphic method is therefore resorted to as being quicker and, to a great extent, self-checking. If each member of the equation is plotted as abscissa with T values as ordinates, two curves are obtained, their intersection giving the value of T which satisfies the entire equation and is therefore the tension to be found. The left-hand member of the equation, plotted for different temperatures, is evidently a system of sloping parallel lines which may be drawn easily once the slope and intercepts for one of them are determined.

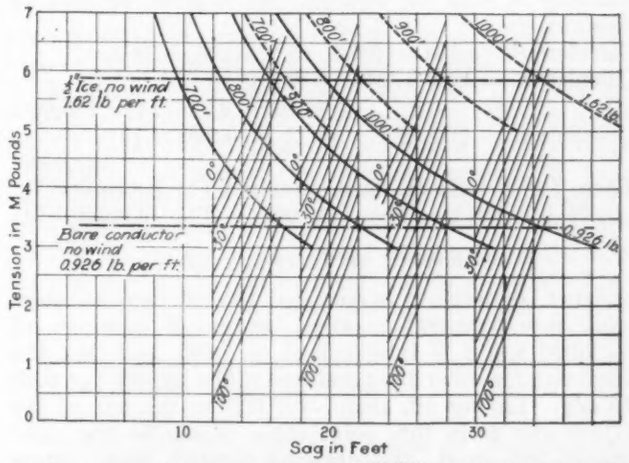


FIG. 1—SAG-TENSION DIAGRAM FOR 300,000-CIRC.MIL STRANDED HARD-DRAWN COPPER BASED ON 7,000 LB. TENSION UNDER CLASS B LOADING AT 0 DEG. F.

Example.—Given a 300,000-circ.mil stranded hard-drawn copper conductor, designed to be stressed to one-half its ultimate strength under Class B loading at

0 deg. F. The tensions under other conditions of loading and temperature are to be determined. The conductor has the following characteristics:

Coefficient of expansion, $a = 9.6 \times 10^{-6}$.
Modulus of elasticity, $M = 16 \times 10^{6}$.
Area of section, $A = 0.236$ sq.in.
Design tension, $T_o = 7{,}000$ lb.
Minimum load, $W = 0.926$ lb. per foot.
Class B load, $W_o = 1.95$ lb. per foot (resultant).
Class B load, $= 1.62$ lb. per foot (vertical).

The above data would have to be collected for any solution and are merely listed here for reference.

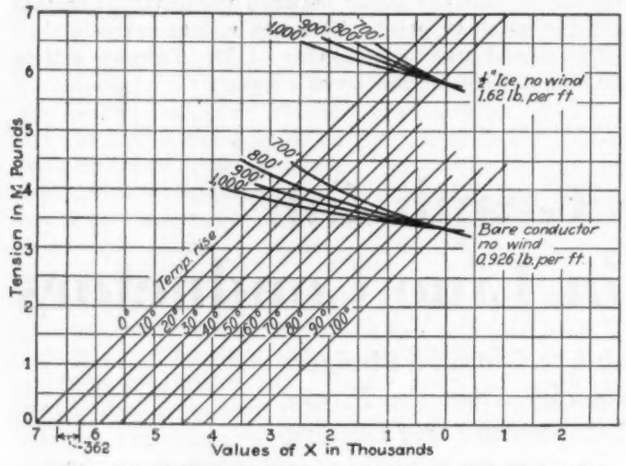


FIG. 2—STRAIGHT-LINE TENSION DIAGRAM FOR THE SAME CONDUCTOR AND BASIC CONDITIONS AS IN FIG. 1

Starting in with the straight-line solution, proceed as follows:

Calculate $B = aMA = 9.6 \times 16 \times 0.236 = 36.2$.

Calculate $K = W^2MA/24 = 0.857 \times 16 \times 10^6 \times 0.236/24 = 135{,}000$.

Calculate $R = (W_o/WT_o)^2 = (1.95/0.926 \times 7)^2 = .0905$.

Then, for a 1,000-ft. span, equation (1) becomes:

$$[36.2t + 1{,}000(T - 7) = 135{,}000[(1/T^2) - 0.0905] \quad (2)$$

EFFECT OF TEMPERATURE

From inspection it is seen that the left-hand member, with zero temperature rise, has an X intercept of — 7,000 and a Y intercept of + 7,000, and that the abscissas for other temperatures differ by 362 for each 10 deg. Laying off, then, — 7,000 to the left of the origin and from this point other points to the right spaced 362 apart, and drawing through these points 45-deg. lines sloping upward and to the right, we have a "temperature grid" upon which the tension curves for any loading and length of span may be superimposed.

HANDLING TENSION VALUES

Plot the second member of equation (2) by finding first the Y intercept,* which is seen by inspection of equation (1) always to have the value $T = \sqrt{1/R}$, or in this case $T = \sqrt{1/0.0905} = 3.33$.

With this intercept as a starting point, values of T are assumed which will extend the tension curves to intersect the temperature grid. The plotting points for minimum load are as follows:

*The Y intercept is the tension at what Professor Still calls the critical temperature, i.e., the temperature at which all spans have equal tension and the same sag as at temperature T_o under loading W_o.

	Assumed Values of T		
	3.5	4.0	4.5
X for 1,000-ft. span	—1,200	—3,780	—5,550
81 per cent for 900-ft. span	— 972	—3,060	...
64 per cent for 800-ft. span	— 768	—2,420	—3,550
49 per cent for 700-ft. span	— 588	—1,850	—2,720

Tension curves may be plotted in the same manner for any other loading, the only change being in the symbols K and R, due to the different value of W. For instance, with the maximum vertical load with ice:

$$K = 1.62^2/0.926^2 \times 135{,}000 = 413{,}000,$$

and $$R = 0.926^2/1.62^2 \times 0.0905 = 0.0296,$$

and Y intercept $= \sqrt{1/0.0296} = 5.82$.

This gives the following plotting points:

	Values of T	
	6.0	6.5
Value of X for 1,000-ft. span	—744	—2,440
Value of 81 per cent for 900-ft. span	—602	—1,980
Value of 64 per cent for 800-ft. span	—476	—1,560
Value of 49 per cent for 700-ft. span	—364	—1,200

SAGS DETERMINED BY OTHER FACTORS

Stress is laid upon the solution for tension for the reason that in any practical problem it is the tension and not the sag that is desired. The two things which it is most necessary to know are (a) the tower height to give a specified clearance to ground and (b) the stringing tension. The height of tower is usually found by means of a template, the curvature of which is based upon the tension and loading under maximum sag conditions and not upon the maximum sag itself. The stringing tension may be read directly from the straight-line tension diagram (Fig. 2). It will be necessary, however, to compare the sags for the maximum temperatures under the various loadings to ascertain what is the maximum sag condition. These, and any other sags which it is desired to know, may be calculated from the familiar parabolic formula:

$$\text{Sag} = \frac{W(\text{span length})^2}{8 \times \text{tension}}.$$

DERIVATION OF STRAIGHT-LINE FORMULA

There is nothing fundamentally new in the method described, it being merely a convenient rearrangement of the well-known parabolic formulas, as follows:

The change in length of conductor from sag D to sag D_o is

$$\text{Delta } C = 8(D^2 - D_o^2)/3L$$

and is equal to the sum of the thermal expansion ($= Lat$) plus the negative elastic contraction due to release of tension $= (T - T_o)L/MA$.

Equating:

$$Lat + (T - T_o)L/MA = 8(D^2 - D_o^2)/3L. \quad (4)$$

Taking moments about one point of support gives

$$D = WL^2/8T. \quad (5)$$

Fig. (1) is the usual graphic solution for finding the values of D and T which will satisfy equations (4) and (5) simultaneously. For the straight-line solution substitute (5) in (4), giving

$$Lat + \frac{(T - T_o)L}{MA} = \frac{L^2}{24}\left(\frac{W^2}{T^2} - \frac{W_o^2}{T_o^2}\right)$$

or

$$aMAt + (T - T_o) = \left(\frac{W^2MA}{24}\right)L^2\left(\frac{1}{T^2} - \frac{W_o^2}{W^2T_o^2}\right)$$

Taking lengths and tensions in thousands and substituting symbols for quantities which are constant for any given problem, we have

$$Bt + 1{,}000(T - T_o) = KL^2\left(\frac{1}{T^2} - R\right) \quad (1)$$

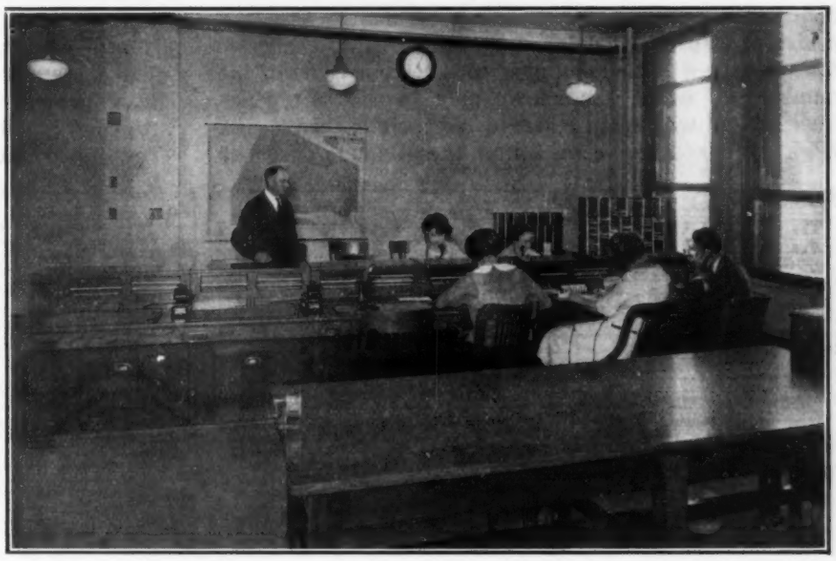
Handling Trouble on the Detroit System

Complete Organization of Department Described in Detail—Extensive Telephone Board to Distinguish Between Customer Complaint Calls and Calls from Outside Repair Men

By H. G. GRANGER
Assistant Superintendent Overhead Lines Detroit Edison Company

THE handling of various kinds of trouble on a large city distribution system has brought about the necessity of organizing a trouble department which will function during twenty-four hours every day in the year. A typical example of such an organization is that in use by the Detroit Edison Company.

The trouble department of this company is under the jurisdiction of the maintenance division of the overhead-lines department, and its organization may be briefly outlined as follows: Three trouble-board dispatchers are employed, one of each class, being on duty during each eight-hour period of the twenty-four-hour day. The dispatchers are in charge of the operation of the trouble department; consequently they have to be men who have had several years' experience and are entirely familiar not only with the company's distribution system but also with the company's policy in dealing with the public. The assistant dispatchers are trained to enable them to assume the duties of the dispatchers whenever the occasion may warrant. There are also four girls, known as trouble-board operators, who receive incoming calls from the public. During severe storms or on any other occasion when an abnormal number of calls come in to the board the dispatcher is authorized to call on the office of the overhead-lines maintenance department for assistance in taking the incoming calls.



TELEPHONE TROUBLE BOARD EMPLOYED BY THE DETROIT EDISON COMPANY

Field Organization of Trouble Department Consists of Fifty Men

The field organization of the trouble department consists of six emergency linemen, nineteen fuse troublemen, fifteen appliance troublemen, three steam-heating troublemen, three underground-lines troublemen and four street-lighting troublemen.

The six emergency men work in pairs, each pair having a fast car and carrying the few supplies necessary to make emergency line repairs only. A pair of emergency linemen are on duty for an eight-hour period, when they are relieved by another pair of men similarly equipped. The emergency linemen make all emergency repairs to distribution lines and also answer all "second" fire alarms in order to see that the company's equipment is properly cleared and electricity cut off from the burning building, as well as to safeguard the company's property. When not out on a trouble call the emergency linemen hold themselves ready to respond to orders, occupying a room which has been especially reserved for them, known by the members of the organization as the patrol room.

The nineteen fuse troublemen report for duty at such respective times in the day as to insure the largest number of them being on duty during the period when experience has shown the greatest amount of fuse trouble develops. After midnight no fuse men are on duty and any fuse calls received after this time are handled by the emergency men. The fuse troublemen are equipped with light cars and call in as required by the trouble-board dispatcher at regular intervals for orders. The fuse troublemen report for duty each day at the patrol room, but after once starting on their day's work do not again come in but receive their orders over the telephone.

The appliance troublemen, although on the payroll of a separate department known as the inspection department, report to the patrol room and receive such orders in connection with their daily work as come to the attention of the trouble-board dispatchers. The steam-heating troublemen are under the jurisdiction of the central heating department and merely receive trouble calls from the trouble board.

The street-lighting repairmen, of whom there are four on duty in shifts from 8 a.m. to 5 p.m. and from 4 p.m. to midnight, handle the patrolling of the various municipal street-lighting circuits in the Detroit municipal district and replace burned-out or broken lamps, globes, etc., as required. Where the circuit has been interrupted by broken poles they restore service to the rest of the circuit and leave permanent repairs to be made by a regular line gang at a later time.

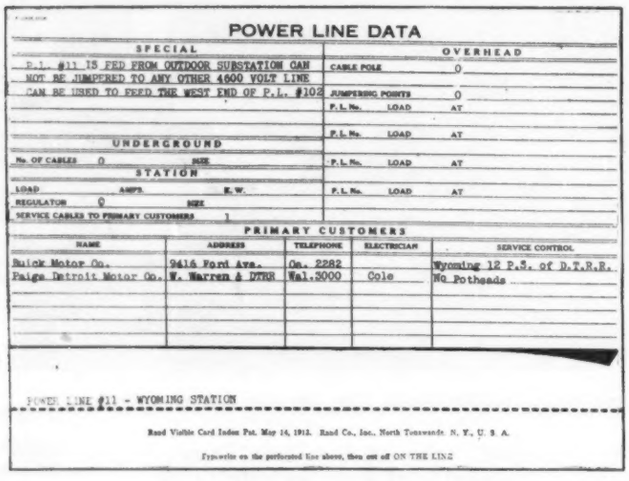
The underground-lines troublemen report to the un-

derground department, but are subject to call by the trouble board in case of any trouble on the underground distribution or street-lighting system.

HANDLING CALLS FROM PUBLIC

Trouble calls from the public are received through a twenty-eight-trunk "PBX" and are relayed to the twelve-position trouble board which has been especially designed for that purpose; but such trouble calls as may come through the company's system operator or load dispatcher enter the board through the company's own private telephone system. Four positions of the trouble board are equipped for the use of dispatchers and assistant dispatchers only. To these positions come two lines equipped with red lights direct from central, the numbers of which are known only to the emergency linemen and which are reserved for their exclusive use. Eight other lines come into these four positions equipped with green lights. These lines are also direct from central, and their numbers are known by the fuse troublemen and other classes of troublemen calling in for orders. To these four positions also come two lines direct from the company's system operator, and by means of control keys the trouble-board dispatcher may listen in to orders given the emergency men directly by the system operator. By means of another control key the trouble-board dispatcher may cause a signal to come in on the company's "PBX," which is promptly answered by the "PBX" operator, thus enabling the former to have calls quickly transferred to other lines. This equipment is so arranged that the "PBX" operator may also quickly get in touch with the trouble-board dispatcher and request him to pick up any call of sufficient importance to take precedence over the regular routine of handling.

The metropolitan territory of Detroit is divided into



POWER LINE DATA

SPECIAL

P.L. #11 IS FED FROM OUTDOOR SUBSTATION CAN NOT BE JUMPERED TO ANY OTHER 4600 VOLT LINE CAN BE USED TO FEED THE WEST END OF P.L. #102

OVERHEAD

CABLE POLE 0

JUMPERING POINTS 0

P.L. No. LOAD AT

P.L. No. LOAD AT

UNDERGROUND

No. OF CABLES 0 SIZE

P.L. No. LOAD AT

STATION

LOAD AMPS K.W.

P.L. No. LOAD AT

REGULATOR 0 SIZE

SERVICE CABLES TO PRIMARY CUSTOMERS 1

PRIMARY CUSTOMERS

NAME	ADDRESS	TELEPHONE	ELECTRICIAN	SERVICE CONTROL
Buick Motor Co.	9414 Fort Ave.	On. 2282		Wyoming 12 P.S. of D.T.R.R.
Paige Detroit Motor Co.	W. Warren & DTRR	Wal.3000	Cole	NO Potheads

POWER LINE #11 - WYOMING STATION

Rand Visible Card Index Pat. May 14, 1912. Rand Co., Inc., North Tonawanda N. Y., U. S. A.

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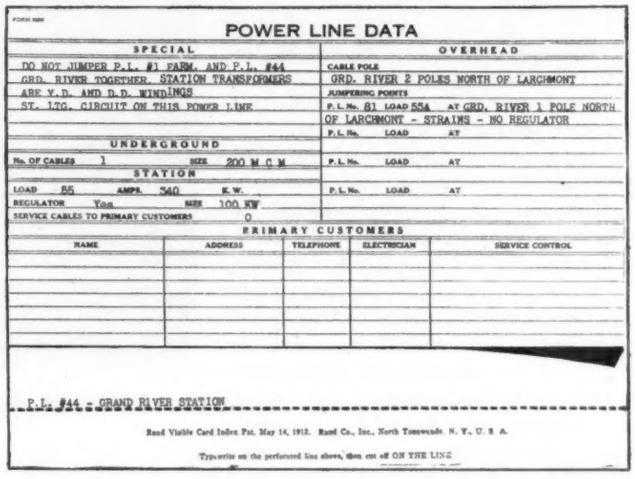

POWER LINE DATA

SPECIAL

DO NOT JUMPER P.L. #1 FARM, AND P.L. #44 GRD. RIVER TOGETHER. STATION TRANSFORMERS ARE Y.D. AND D.D. WINDINGS ST. LTG. CIRCUIT ON THIS POWER LINE

OVERHEAD

CABLE POLE GRD. RIVER 2 POLES NORTH OF LARCHMONT

JUMPERING POINTS

P.L. No. 81 LOAD 55A AT GRD. RIVER 1 POLE NORTH OF LARCHMONT - STRAINS - NO REGULATOR

P.L. No. LOAD AT

UNDERGROUND

No. OF CABLES 1 SIZE 200 M C M

P.L. No. LOAD AT

STATION

LOAD 55 AMPS. 540 K.W.

P.L. No. LOAD AT

REGULATOR Yes SIZE 100 KW

SERVICE CABLES TO PRIMARY CUSTOMERS 0

PRIMARY CUSTOMERS

NAME	ADDRESS	TELEPHONE	ELECTRICIAN	SERVICE CONTROL

P.L. #44 - GRAND RIVER STATION

Rand Visible Card Index Pat. May 14, 1912. Rand Co., Inc., North Tonawanda N. Y., U. S. A.

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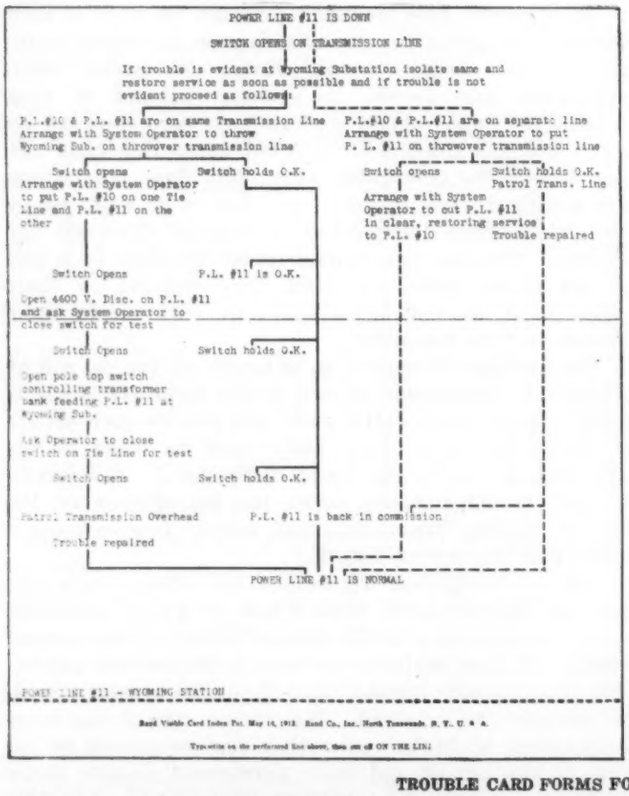
POWER LINE #11 IS DOWN
SWITCH OPENS ON TRANSMISSION LINE
If trouble is evident at Wyoming Substation isolate same and restore service as soon as possible and if trouble is not evident proceed as follows:
P.L.#10 & P.L. #11 are on same Transmission Line Arrange with System Operator to throw Wyoming Sub. on throwover transmission line
P.L.#10 & P.L.#11 are on separate line Arrange with System Operator to put P. L. #11 on throwover transmission line
Switch opens
Switch holds O.K.
Arrange with System Operator to put P.L. #10 on one Tie Line and P.L. #11 on the other
Switch opens
Switch holds O.K.
Patrol Trans. Line
Arrange with System Operator to cut P.L. #11 in clear, restoring service to P.L. #10
Trouble repaired
Switch Opens
P.L. #11 is O.K.
Open 4600 V. Disc. on P.L. #11 and ask System Operator to close switch for test
Switch Opens
Switch holds O.K.
Open pole top switch controlling transformer bank feeding P.L. #11 at Wyoming Sub.
Ask Operator to close switch on Tie Line for test
Switch Opens
Switch holds O.K.
Patrol Transmission Overhead
P.L. #11 is back in commission
Trouble repaired
POWER LINE #11 IS NORMAL
POWER LINE #11 - WYOMING STATION
Rand Visible Card Index Pat. May 14, 1912. Rand Co., Inc., North Tonawanda N. Y., U. S. A.
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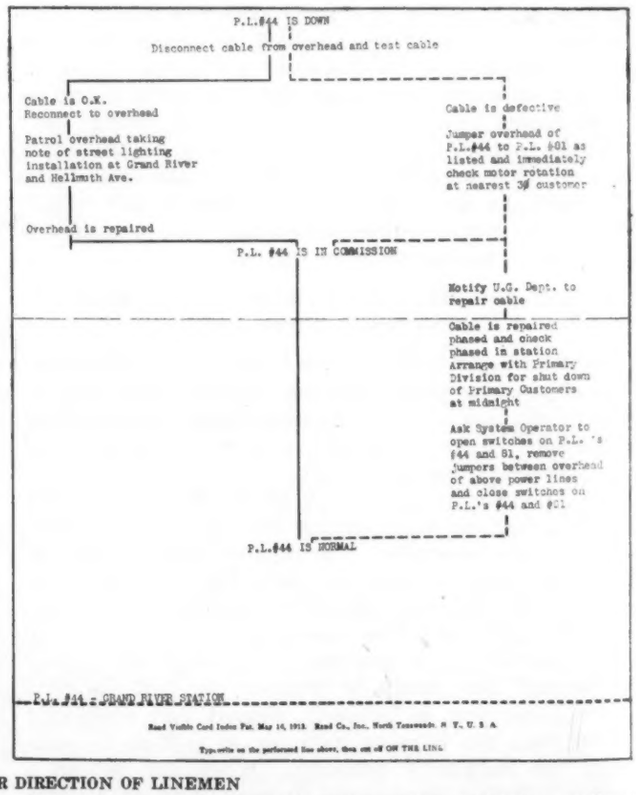
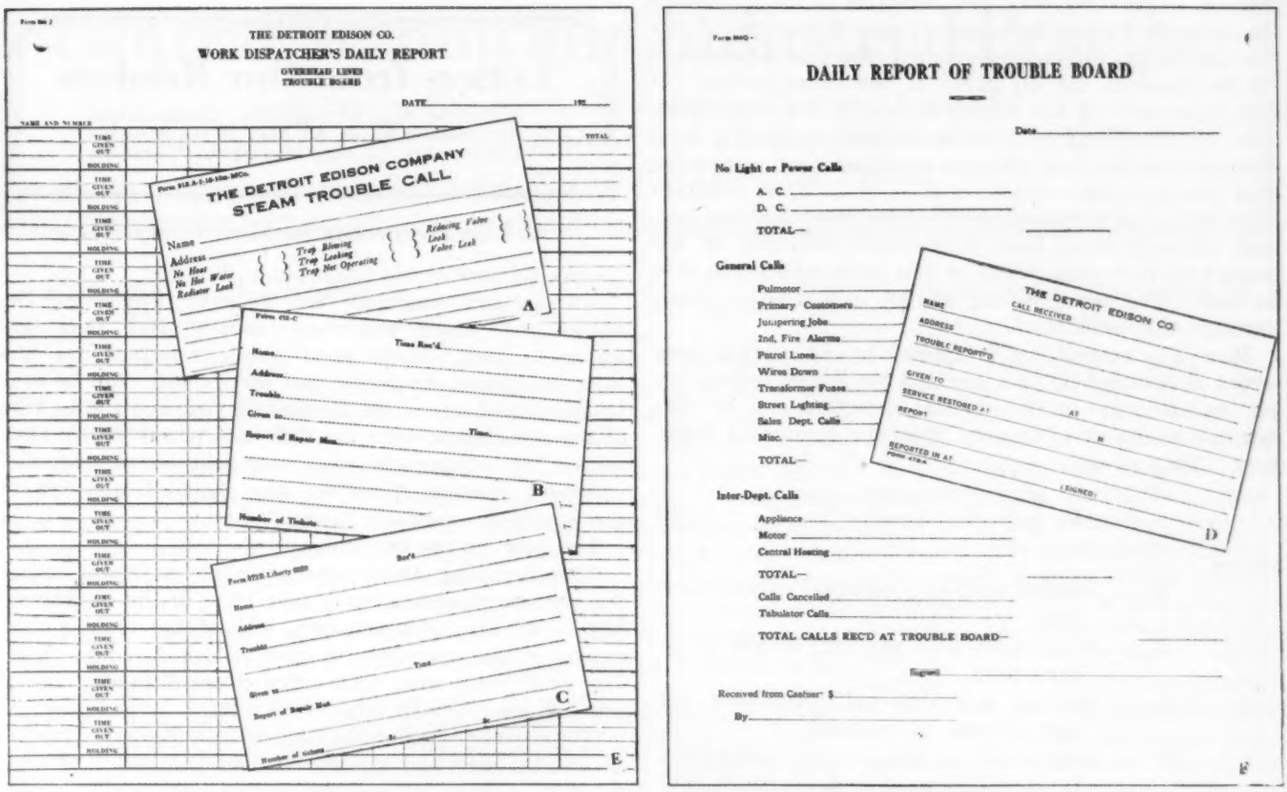

P.L.#44 IS DOWN
Disconnect cable from overhead and test cable
Cable is O.K.
Reconnect to overhead
Patrol overhead taking note of street lighting installation at Grand River and Hellmuth Ave.
Overhead is repaired
Cable is defective
Jumper overhead of P.L.#44 to P.L. #01 as listed and immediately check motor rotation at nearest 3ϕ customer
P.L. #44 IS IN COMMISSION
Notify U.G. Dept. to repair cable
Cable is repaired phased and check phased in station
Arrange with Primary Division for shut down of Primary Customers at midnight
Ask System Operator to open switches on P.L. 's #44 and 81, remove jumpers between overhead of above power lines and close switches on P.L.'s #44 and #21
P.L.#44 IS NORMAL
P.L. #44 - GRAND RIVER STATION
Rand Visible Card Index Pat. May 14, 1912. Rand Co., Inc., North Tonawanda N. Y., U. S. A.
Typewrite on the perforated line above, then cut off ON THE LINE

TROUBLE CARD FORMS FOR DIRECTION OF LINEMEN

Upper shows obverse side, on which is recorded all information about the line, where to jumper and so forth, in case of trouble. On lower reverse side the procedure in restoring service is given graphically. The lineman follows the various possible procedures shown in the illustration according to the conditions as he finds them for that particular circuit.



FORMS USED IN HANDLING TROUBLE ON THE DETROIT EDISON SYSTEM

A—(Salmon)—Steam trouble call. B—(Blue)—Appliance call. C—(Pink)—Motor call. D—(White)—Fuse call. E and F—Trouble-board daily records and reports.

a number of districts for the purpose of properly distributing the troublemen. A board representing this territory is designed with a number of holes, and each troubleman is represented by a plug bearing his particular number. The various plugs are placed in the holes in the board in accordance with the district in which the man represented may be working. In this manner the dispatcher, by efficiently routing the calls, is enabled to give the customer prompt service.

Incoming calls are classified according to the nature of the trouble, are written on forms of various colors and are placed in a pigeonhole allotted to the district in which the trouble occurs until given out to a troubleman calling in, when they are placed in another pigeonhole assigned to this man. Calls pertaining to the operations of the distribution system are recorded by the dispatcher in a log. Consequently, when a change of dispatchers occurs the new man reporting for duty may take up the work where it was left by his predecessor and has before him a complete history of all operations which have been completed prior to his coming on duty.

Maps for Use of Dispatchers

Detailed maps of the system are placed in convenient files for the use of the dispatchers in cases of trouble, and a filing system has been devised with a card for each line on the system. This card gives all information necessary to handle trouble on its particular line, such as cable-pole locations, jumpering points and the routine to be followed in order to clear any given sort of trouble properly.

Altogether the trouble-shooting system has been so arranged as to make its operation as efficient as possible, and the infrequency of errors, as well as the rapidity with which serious cases of trouble are handled, tends to show that the effort expended on making it an ideal system has been very far from wasted.

Effect on Metal-Covered Telephone Cables of Adjacent Power Lines

ALTHOUGH the problem of inductive co-ordination between a lead-covered telephone cable and an alternating-current transmission line has been investigated extensively in the past by many agencies, very little has been done with telephone cables armored with other metals. Prof. H. Pleijel, in the Sept. 1 issue of *Teknisk Tidskrift* (Stockholm, Sweden), considers this problem in detail, studying the characteristics of cables covered with copper or iron. He shows that in each of these metals certain assumptions have to be modified on account of the different permeability and resistivity. Since the current in the covering will be small, the permeability μ may be assumed to be constant.

The magnetic field may, therefore, be considered as the resultant of the field due to the external current alone and the field due to the current in the armor. The same condition will hold for the electric field. The length of line considered is assumed to be large in comparison with the distance between the alternating-current line and the telephone line, but small in comparison with the wave length of the electromagnetic

waves. Therefore, the electromotive force, E, which is induced in the telephone line on account of the current in the alternating-current line may be assumed to be constant for all parts of the cross-section. If the component of the electrical field in the axial direction of the telephone line is designated by E_o, it is evident that the field which is produced by the covering and the grounded return is $E - E_o$. This resultant field varies for different points below the telephone line, and since it must have a reversed direction in the return current path, there is one point where the field is zero. The zero line for electric potential is drawn through this point.

Maxwell's second law is applied to the vertical area which is bounded by this line and the lowest generatrix on the covering in the vertical direction and by two vertical planes at a distance dl in the horizontal direction. This gives,

$$E = E_o \frac{Z + R_i + j\omega(L_i - M')}{Z + R_i + j\omega(L_i - L_y)} \qquad (1)$$

where

E = induced emf. in conductors of telephone line.

Z = ohmic resistance per unit length of return path.

L_i and L_y = internal and external inductance per unit length of covering.

M' = component of the mutual inductance $L_y + M'$ between unit length of covering and unit length of conductors of telephone line.

In case of a lead armor the term $j\omega(L_i - M')$ will be small and may be neglected. Equation (1) is then reduced to the common formula for E.

The main part of the article consists in determining the values of $R_i + j\omega L_i$ and $j\omega M'$. The magnetic field H and the electric field E in the covering are evaluated by Maxwell's equations, giving H and E in terms of Bessel's functions of both kinds ($j_o x$ and $k_1 x$). The independent variable x is, for convenience, not the radius r, but a function of r given by:

$$x = r\sqrt{-4\pi j\omega\lambda\mu}, \qquad (2)$$

where

ω = angular frequency of telephone current, and

λ = inversed value of resistivity of material in covering.

It is found that:

$$R_i + j\omega L_i - j\omega M' = \frac{2j\omega\mu}{j_o' x_2 k_o' x_1 - j_o' x_1 k_o' x_2} - \frac{1}{x_1 x_2}, \qquad (3)$$

where $j_o' x$ and $k_o' x$ represent the first derivatives of the Bessel's functions and x_1 and x_2 correspond to the limiting values of r.

The subsequent discussion of the result indicates that for a thick covering the value of $R_i + j\omega L_1 - j\omega M'$ becomes very nearly that of the ohmic resistance. This is especially true for low frequencies. An increase in frequency will increase the induction up to a certain point where there is only partial permeation of the electromagnetic waves. For frequencies above this value the induction will decrease. The limiting frequency will be lower for an iron covering than for a lead covering on account of the difference in permeability, and it will be lower for a copper covering than for an iron covering on account of the difference in resistivity.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

Is This Happening in Your Company?

To the Editors of the ELECTRICAL WORLD:

An electrical engineer was recently discussing the obligations which engineers usually feel they are under to help obtain good public relations for the light and power companies that serve them. But he said he had moved into a new territory a year ago and he told of his experiences with the light and power utility that served him during the past year and ended with the pertinent question, "And so, why should I step out of the way to do them any favors?"

And now for the incidents:

"One Saturday about noon while my wife was using the vacuum cleaner a main fuse blew in the basement. She called the light company, told of the trouble and requested that they send a man to install a new fuse. The gruff reply was, 'This office closes Saturday noon; you will have to wait until Monday.'

"On another occasion the electric iron got out of order on ironing day and my wife called the company and asked if it could be repaired immediately if she would send it to the company by messenger. They asked her the make of the iron and, when told, abruptly closed the conversation with the statement, 'We can't do anything for you; we handle only ——— irons.'

"Again the light company advertised a mammoth sale of table lamps at one-third off the regular price. Needing a lamp, my wife and I went to the company store. We found the assortment meager, the lamps of poor quality and the prices high in spite of the price cut. Leaving the store reluctantly without purchasing a lamp, we passed the window of an electrical dealer a few doors away and were attracted by the lamps on display. Going in, we found just the lamp we wanted at a price much less than that asked by the light company for lamps of inferior quality.

"Finally, I desired a sewing-machine motor and took a rather long trip to the largest of the light company stores. Entering, I waited quite a long time until a clerk strolled up from the rear and casually inquired, 'What do you want?' I told him, and he took me to a table where several motors were displayed. After looking them over I asked him to operate the one I had selected. He tried several cords, plugs and receptacles, finally found that the circuits were dead and then said, 'Well, anyway, you can see that it's all right and will work.' I then asked him if the motor could be attached easily to my make of sewing machine, which is nationally known. He replied, 'I don't know; you will have to go home and take some measurements to find out.'

"Can you blame me for not doing much to develop public sentiment favorable to the company?"

I couldn't. A BOOSTER FOR BETTER SERVICE.

[Our correspondent relates an aggravated case which fortunately is the exception rather than the rule among electric light and power utilities today. The progressive company has learned that it pays to put "service" first, not only as a matter of common civil treatment of the customer but also as a matter of sound business policy.—EDITORS.]

Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

Prevention of Clinker Formation

By D. C. Hess
Stoker Engineer Service Department, Westinghouse Electric & Manufacturing Company, Philadelphia

CLINKER trouble is usually not very pronounced in most underfeed stoker installations until high ratings are reached and high furnace temperatures are being maintained. If the coal being used contains a low fusing ash, it is evident that clinker trouble will be encountered. Clinkers in the fuel bed are hard to avoid, and in cases where they do not move to the rear with the movement of the fuel bed a hook or slice bar has to be used. Recent changes in the design of boiler bridge walls tend to decrease furnace temperature and with it to some extent the formation of clinkers. This is accomplished, as shown in the accompanying illustration, by sloping the front surface of the bridge wall backward so that the rays of heat impinging upon it reflect directly into the boiler tubes and not back into the fuel bed. Moreover, the latest engineering practice is to expose all tube surface possible to the fire, thereby decreasing the furnace temperature.

In some plants side-wall and bridge-wall clinker troubles are avoided by the use of steam jets. On the other hand, many plants are using side-wall tuyères in connection with underfeed stokers as shown herewith. These side-wall tuyères are cast-iron air boxes which extend above the side retorts and down along the side walls. They are rectangular in shape and fit closely together, but allow room for expansion and contraction. A large cored central space feeds air to the holes in the surface. The air issues at right angles to the wall or tuyère face. At plants where these side-wall tuyères are in use the side-wall clinker trouble has been entirely eliminated and the life of the boiler walls has been considerably increased. The maintenance of the tuyères is very low, because of air cooling the metal, and stokers equipped with these tuyères burn high-ash Western coals and low-ash Eastern coals equally well. Several furnaces have been in operation more than three years with very satisfactory results. The air admitted through these side-wall tuyères does not decrease the CO_2 as the air is admitted below the surface of the fuel bed and serves as an aid to complete combustion.

SIDE-WALL TUYÈRES USED IN FURNACE SETTINGS REDUCE CLINKER FORMATION AND LOWER MAINTENANCE COST MATERIALLY

Causes and Prevention of Control Failure

By Frederick L. Roth
Assistant Chief Electrician Cos Cob Power Plant, N. Y., N. H. & H. R. R.

THE first point to be determined when automatic switches and protective apparatus fail to function is the maximum number of pieces of apparatus that might under any possible condition be caused to operate simultaneously. This will give the maximum current required from the source of control current. Other factors to be carefully investigated are the voltage drop in the control wiring and whether the control voltage is too low or too high. The writer has known of instances wherein protective apparatus has failed to function, disastrous results ensuing, for the simple reason that the control voltage was too low at the critical moment. In almost any installation the tripping coils should not be wound for more than 50 to 75 per cent of the control voltage, as the control voltage is impressed upon tripping coils for only very brief periods and can do no harm when the control voltage is at or slightly above normal, but insures positive operation of all equipment should the control voltage for any reason be below normal.

Then, again, there arises the case of control voltage being too high, which is often a serious factor in the destruction of operating mechanism. For example, an operator found that by raising the control voltage considerably above normal when about to synchronize generators he could get almost instant operation of the switches, thereby lessening the possibility of closing them at the wrong time. This practice caused an extensive breakage of switches until the fact of raising the voltage was detected. There are also instances where an excessive voltage caused certain switches to close and open several times when synchronizing, with disastrous results to both apparatus and system voltage. Low voltage will often cause certain switches not to reach their full

closed position or to open when the control switch is released.

A storage battery of ample capacity with an induction-motor-driven generator is one of the best sources of control current. The control wiring should be of such size that under no circumstance would the voltage drop become excessive. The battery should be of sufficient capacity to maintain control voltage at times of greatest requirement. At least five end cells capable of being placed in circuit one by one or en bloc should be provided. A graphic voltmeter of sufficient range to record charging voltage without passing over the scale of chart should be connected across the main cells of the control battery. This voltmeter will indicate at all times the operation of battery floating, charge and discharge.

There should be a fixed number of cells (main battery) connected across the control bus. The motor-generator should be floated on the control bus with its field so adjusted as to furnish at all times the required current for pilot lamps, etc., leaving the battery floating at zero current. The release for the motor-generator when delivering current should be set for an overload of 50 to 100 per cent, but the reverse-current release should be as low as possible, so that at no time will the battery be driving the motor-generator. There should also be a graphic voltmeter connected across the control bus permanently, so that the voltage of control bus will be recorded at all times. Ground lamps across the control bus instantly indicate the existence of a ground. It is also well to connect an audible signal to the control bus to insure the giving of a signal when the voltage drops to a low value. This alarm can also be arranged to give warning should the motor-generator for any reason be released from the control bus, as in the case of its circuit breaker dropping out and the battery discharging, with the attendant drop in its voltage and the possible resultant failure of automatic apparatus to function.

With a source of control current arranged as outlined and a battery of sufficient capacity, there will be little likelihood of apparatus failing to function, other conditions being equal.

Water Measured by Salt-Velocity Method

Theory and Development of Apparatus—Actual Commercial Tests of Apparatus Described—High Degree of Accuracy and Reliability Claimed

NOTABLE progress in the accuracy of measuring the flow of water in penstocks was recorded in a paper on the above subject at the recent New York meeting of the American Society of Mechanical Engineers by Prof. C. M. Allen of the Worcester (Mass.) Polytechnic Institute and Edwin A. Taylor. The salt-velocity method is based on the introduction of a salt solution into the water in a pipe line and determining by electrical indicating and recording instruments the time interval required for the solution to pass between selected points equipped with electrodes and wired to a suitable source of energy supply. The method has the advantages of simplicity, high accuracy and low cost, especially in its application to low-head plants with short concrete penstocks of varying cross-section.

Exhaustive laboratory investigations leading to field tests upon large units and extensive check tests indicate that under like conditions consistent results can be repeatedly obtained. In the fall of 1922 tests were made at the Grand' Mère (Que.) hydro-electric plant of the Laurentide Power Company, Ltd., to determine the reliability of the salt-velocity method when applied to short rectangular tapering penstocks in the field. A 102-in. I. P. Morris wheel (Fig. 1) rated at 22,000 hp. under 84-ft. head was used. The penstock was a sloping concrete tube about 65 ft. long, converging from a vertical rectangular cross-section of 630 sq.ft. at the upper end to a vertical rectangular cross-section of 355 sq.ft. at the piezometer plates at the entrance to the scroll case. The saline solution was introduced under pressure from a mixing tank through twenty-four pop valves inserted in the penstock bays and controlled by a 4-in. quick-acting valve with a 30-in. hand wheel (Fig. 5). During the final tests, which included readings for determining the efficiency of the unit, six pairs of electrodes placed about 22 in. downstream from the plane of the pop valves were used to give the injection readings, the electrodes being of 4-in. x ½-in. steel plate, 10 ft. long and placed parallel to the thread of the penstock.

The dimensions of the penstock were carefully measured before the tests, and the volumes between the vertical planes of the various electrodes and the pop valves were accurately computed. From the instrumental charts recording the electrical indications synchronizing with the passage of the brine across the electrodes were counted the number of seconds required for the salt to pass between two stations. The volume in cubic foot for that section, divided by the time in seconds, gave the flow in cubic feet per second. Subsequent investigations by the engineers of the Laurentide company of the relation between the density of the salt and the electrical conductivity of the solution showed that any error caused by varying the density of the salt solution at the different electrodes can be ignored. With the various apparatus and methods used at Grand' Mère, the maximum variations in water flow by the salt velocity method were + 1.3 per cent and — 2.5 per cent, with an average variation of 0.1 per cent for the whole.

During the fall of 1922 ten successful commercial tests were made by the salt-velocity method, all on hydro-electric plants and including the Shawinigan Falls (Que.) plant of the Shawinigan Water & Power Company. On seven tests the discharge valves were used in computing the efficiency of the units, and on two they were used to calibrate meters. Various tyes of electrodes were employed. In most cases two plates were used for each set, but in some instances three parallel plates were used to get more surface and a greater deflection of the meter needle. Fig. 3 shows a design using three copper plates. Another test on a large unit in Canada confirmed the accuracy of the salt-velocity method on rectangular converging tubes, and many tests verified the accuracy of the method on round penstocks. Screens and grids were also shown to be ideal for both introduction and final electrodes. Greatly improved recording equipment has been designed since the earlier tests, the charts of Fig. 4 being typical. The so-called "integrator," designed after the suggestions of M. Thibeault of the Laurentide company (wiring diagram, Fig. 2), meets the convenience

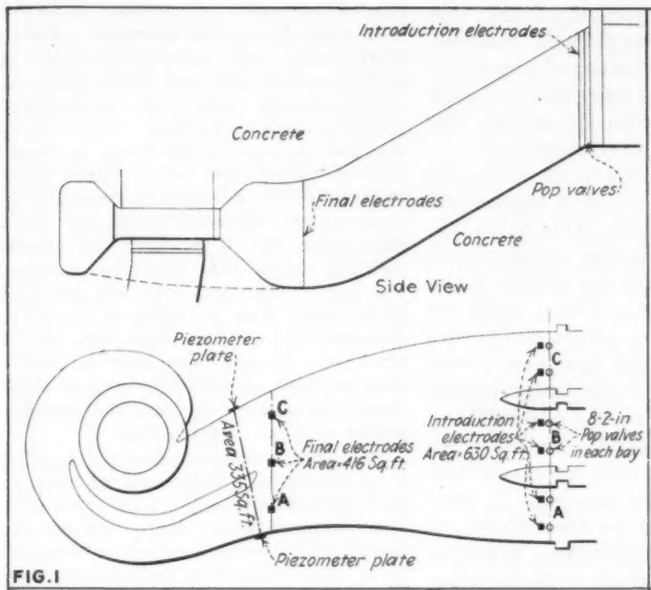


FIG. 1

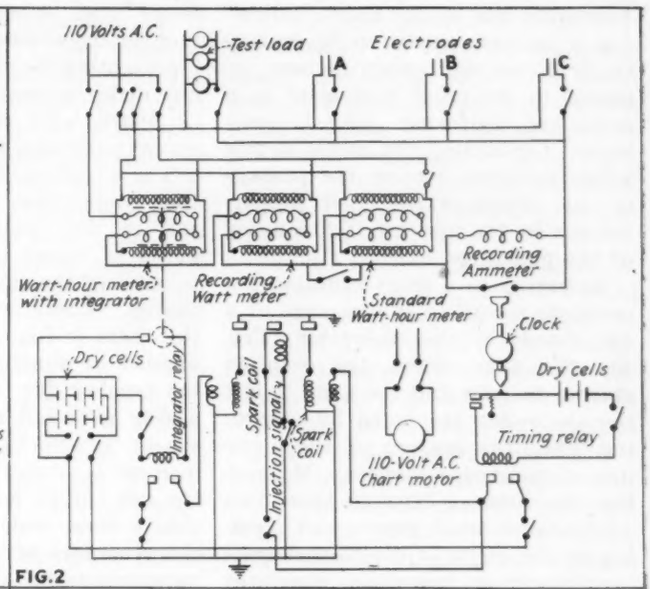


FIG. 2

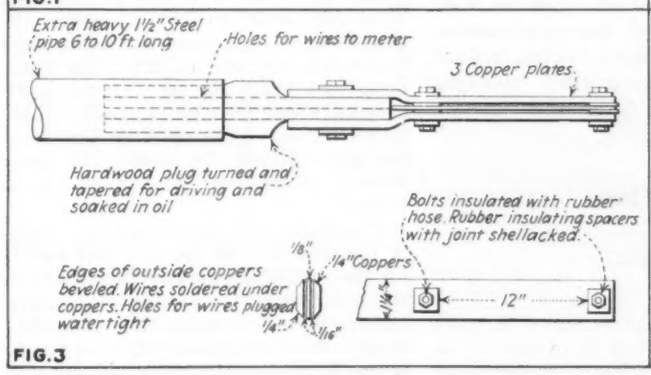

Extra heavy 1½" Steel pipe 6 to 10 Ft. long
Holes for wires to meter
3 Copper plates
Hardwood plug turned and tapered for driving and soaked in oil
Bolts insulated with rubber hose. Rubber insulating spacers with joint shellacked
Edges of outside coppers beveled. Wires soldered under coppers. Holes for wires plugged watertight
⅛"
¼" Coppers
12"
¼"
1/16"

FIG. 3

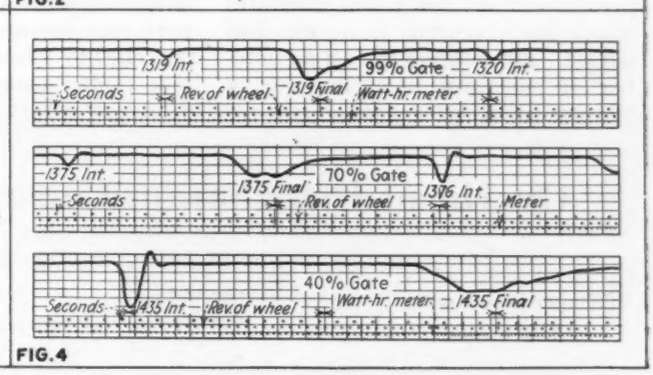


FIG. 4

of alternating current in the salt electrode circuits. The wattmeter and the watt-hour meter were of the commercial polyphase type (although single-phase current was used), with the two potential elements in parallel and the two current elements in series to double the torque and augment the quickness of the instruments to respond to changes in the load. The recording ammeter and recording wattmeter were of the ordinary type.

The object of this integrator is to determine by exact, simple, easily workable and graphical means the instant when one-half of the salt-solution charge has passed the electrode. A commercial watt-hour meter is connected with its current coil in series with the electrodes and with its potential coil energized by a constant voltage. On the rotating shaft of the meter is mounted a simple circuit interrupter giving twenty-four interruptions per revolution to its circuit, which is a local direct-current circuit through the actuating coil of a simple contact-opening relay. These contacts in turn energize the low-tension side of a spark coil of which the high-tension leads are connected to a spark gap. A spark punctures the recording-wattmeter chart at every interruption of the interrupter circuit.

The spacing between punctures will vary inversely as the speed of the watt-hour-meter disk, and consequently inversely as the conductivity of the liquid between the electrodes. While water only is passing the spacing should be uniform, but while the salt solution charge is passing the spacings become smaller. This corresponds to the curve of the recording instrument, the ordinates of which are low and uniform under the former condition and higher under the latter.

The recording wattmeter gives a measure of the amount of salt in the charge (assuming constant velocity and a straight line relationship between salt density and conductivity) in the area of that part of the curve lying above the horizontal line representing the conditions when no salt is passing.

A measure of the salt passing is also recorded by the integrator. The

FIG. 1—SCHEME OF MOUNTING ELECTRODES IN LAURENTIDE PENSTOCK

FIG. 2—WIRING DIAGRAM FOR SALT-VELOCITY ELECTRICAL TEST INSTRUMENTS

FIG. 3—THREE-PLATE ELECTRODE

FIG. 4—COMPLETE RECORD OF PASSAGE OF SALT CHARGE BY THE INTEGRATOR

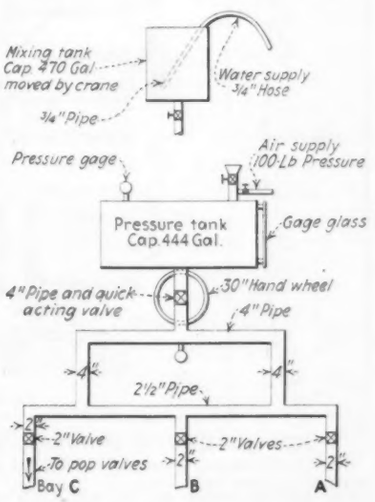


FIG. 5—DIAGRAM OF SALT DISTRIBUTION SYSTEM

horizontal line on the chart, indicating a uniform condition of conductivity of normal water, is here replaced by its exact equivalent in a series of uniformly spaced punctures. Conductivity in excess of this value occurring during the passage of salt demonstrates itself proportionally by the increase in frequency of the punctures.

Referring to a chart containing a complete record of the passage of a salt charge by the integrator (Fig. 4), the time when the solution started to pass and the time it left the electrodes are noted by observing when the spacing of the lower line of punctures changes. Measuring the distance between these two (initial and final) points and dividing by the length of the normal spacing determines how many punctures would have occurred if no salt had passed. By counting the actual number of punctures occurring during the period of salt passage just selected and subtracting from this number the number derived as above, representing the number of punctures due under normal conditions of flow of water with no salt added, the excess punctures are determined.

The resultant figure of excess is thus proportional to the amount of salt in the charge. One-half this figure of excess is also proportional to one-half the quantity of salt in the charge. Therefore, if that point on the chart is found where the actual number of puncture spacings minus the number due to the water before dosing with salt equals one-half the excess of the total passage, the moment is established when one-half the salt charge has passed. To provide a time scale on the charts of the recorders of all types, a device puncturing the sheet with a jump spark was adopted, the spark being controlled by a relay actuated in turn by a contact-making clock marking one-second intervals on the chart.

Overhead Distribution Construction

Standardized Practice as Developed and Used by the
WEST PENN POWER COMPANY, PITTSBURGH

Pole Specifications

General.—Poles must be cut from sound timber and shall be well proportioned from butt to top. Both ends must be squared, the bark peeled and all knots and limbs close-trimmed. No poles having more than one complete twist in grain for any 20 ft. in length or having large season cracks will be accepted. No poles having cat faces, unless such cat faces are small and perfectly sound and poles have an increased diameter at the cat face, and no poles having cat faces near the 6-ft. mark or within 10 ft. of the top, will be accepted. Poles must not show sap rot or have evidence of attack by ants, worms, grubs, other insects or fungus growth. Poles must not show a short crook or bend, or crook or bend in two planes, or a reverse curve. The amount of sweep (middle ordinate of the chord, see Fig. 1) measured between the 6-ft. mark from the bottom and the top of the pole that may be present in acceptable poles is given in Table I.

All poles shall be subject to inspection by the purchaser's representative either in the woods where the trees are felled or at point of shipment. Each pole thus inspected shall be marked according to its length by the purchaser's representative.

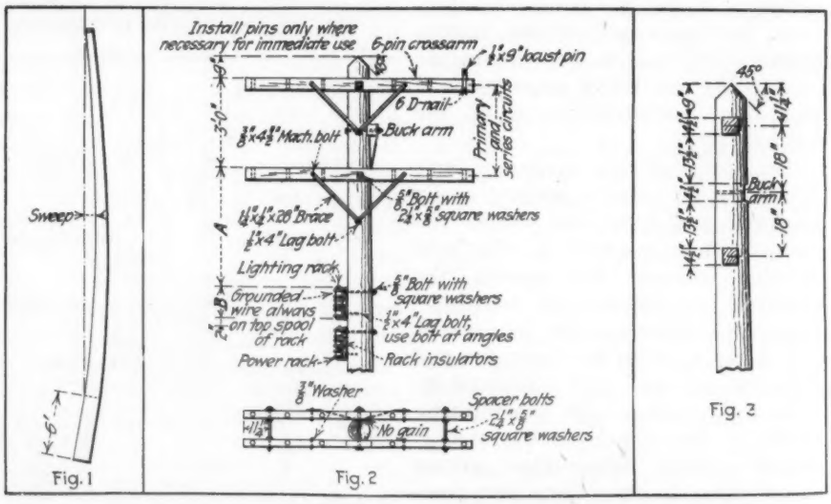
Circumference of Poles.—The circumference at the top of chestnut poles and 6 ft. from the butt shall not fall more than ½ in. below that given in Table II, nor shall the length be more than 3 in. short. The circumference at the top of Western red cedar poles and 6 ft. from the butt shall not fall more than ½ in. below that given in Table III, nor shall the length be more than 3 in. short.

Length and Class.—In general, Class B poles shall be used for ordinary distribution lines. Class B poles shall be used in congested districts and for poles that may carry two or more cross-arms, a transformer installation or a street lamp. For important feeder lines, or where it is necessary to meet special conditions, poles of greater strength than class B may be specified. Where 30-ft. poles are permissible and no primary wires and not more than one street-lighting wire will be required class C poles may be used. Poles carrying two or more cross-arms, a transformer installation or a street lamp shall be 35 ft. or more in length. On unimportant streets where not more than four No. 6 primary or street-lighting wires will ever be required and joint construction is not probable 30-ft. poles may be used, if adequate clearance for service drops, etc., can be obtained. Longer poles may be necessary to clear obstacles, utility or other crossings, because of franchise requirements or joint construction.

Pole Treatment.—Cedar poles, class B or stronger, will in general have an open-tank treatment of hot preservative, applied before the poles are received. Untreated cedar or chestnut poles shall receive a brush treatment from the butt to 18 in. above the ground line. All gains and roofs shall be treated the same as butts. The brush treatment shall consist of two applications, about two hours apart, of hot preservative. Poles shall be dry when the applications are made. If green poles must be used, they shall not be treated.

Framing.—All poles shall be roofed in the direction of the line and gained for their ultimate capacity before being set, according to the type of line and its location. Ordinarily two gains shall be cut (see Figs. 2 and 3). Gains must be made just wide enough to make a snug fit to the cross-arm. Poles requiring steps shall be bored for steps before being set. The side of the pole on which the gains are placed is known as the face of the pole. Gains shall be placed on the straightest side of the pole.

Selection.—Care shall be taken to select the stronger poles for use at



ALLOWABLE SWEEP AND FRAMING REQUIREMENTS OF DISTRIBUTION POLES

Fig. 1—Allowable sweep for different pole heights is given in Table I.

Fig. 2—For dimension "A," for 2,300 volts or 4,000 volts, use 4-ft. normal spacing between top of second gain and top of secondary rack. Never use less than 2 ft. for this spacing. For 6,900 volts use 2-ft. normal spacing. For dimension "B," 12¾ in. for three-part rack, 16¾ in. for four-part rack and 20¾ in. for five-part rack.

Fig. 3—Holes for ⅝-in. bolts to be ¹¹⁄₁₆-in. diameter, gain to be 4½ in. x ½ in., to fit snugly. Gain for buck arm only when buck arm is to be installed.

TABLE I—ALLOWABLE SWEEP IN POLES

Length of Poles, Ft.	Maximum Sweep, In.	Length of Poles, Ft.	Maximum Sweep, In.
30	10	55	11
35	10	60	12
40	10	65	13
45	10	70	14
50	10	..	..

TABLE II—CIRCUMFERENCE IN INCHES OF CHESTNUT POLES

Length of Poles	Class A Top	Class A 6 Ft. from Butt	Class B Top	Class B 6 Ft. from Butt	Class C Top	Class C 6 Ft. from Butt
30	24	40	22	36	20	33
35	24	43	22	39	20	36
40	24	45	22	42	20	39
45	24	48	22	46	20	43
50	24	51	22	49	..	..
55	22	54	22	53	..	..
60	22	57	22	56	..	..
65	22	60	22	59	..	..
70	22	63	22	62	..	..

TABLE III—CIRCUMFERENCE IN INCHES OF WESTERN RED CEDAR POLES

Length of Pole	Class AAA Top	Class AAA 6 Ft. from Butt	Class AA Top	Class AA 6 Ft. from Butt	Class A Top	Class A 6 Ft. from Butt	Class B Top	Class B 6 Ft. from Butt	Class C Top	Class C 6 Ft. from Butt
30	28	40	26	38	24	36	22	34	20	32
35	28	42	26	40	24	38	22	36	20	34
40	28	44	26	42	24	40	22	38	20	36
45	28	47	26	44	24	42	22	40	20	38
50	28	49	26	47	24	44	22	42	..	..
55	28	52	26	49	24	47	22	44	..	..
60	28	54	26	52	24	49	22	47	..	..
65	28	56	26	54	24	52	22	49	..	..

angles, dead-ends, crossings and for mounting transformers and street lights. The more crooked and otherwise objectionable-looking poles should be used upon unimportant streets, alleys or roads.

Lowering Street-Lighting Maintenance Costs

BY W. E. RICHARDS
Superintendent Electrical Department, Toledo (Ohio) Edison Company

IN COMMUNITIES where the local utility company is charged with the responsibility of both operating and maintaining the street-lighting system there may often be delay in cleaning the globes because of the difficulty of finding a satisfactory washing compound. In Toledo a trial of the cleaning compounds used for cleaning glass in office buildings has brought very good results.

The street illumination in Toledo is provided by luminous magnetite lamps fitted with the No. 108 stippled globes. Since much soft coal is burned in this territory, the illuminating qualities of these units are considerably lowered unless the globes are kept clean. Two men with a ladder and a 3-gal. pail of the cleaning solution can cleanse about eighteen globes an hour where the lamps are on 90-ft. centers and two to a pole. This cleaning solution consists of 8 oz. of cleaning compound dissolved in approximately 3 gal. of cold water. The globe is opened up and thoroughly sponged with this solution. Another sponge is used to dry the globe. More than 200 globes in the downtown district have been cleaned with only 3 gal. of the mixed solution. Since this compound does not form suds, being free from animal fat or other greases, it cleans without leaving a slippery surface to be rubbed dry, thereby saving much labor.

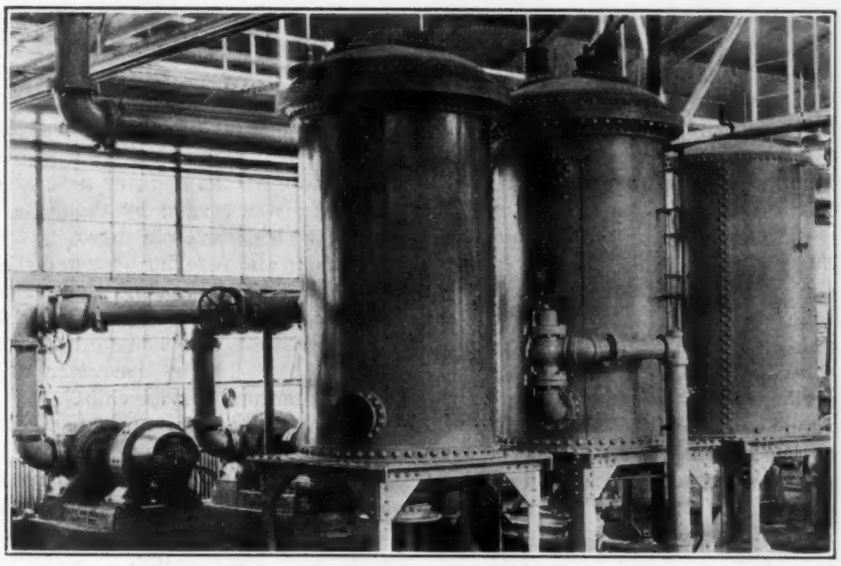
Electrically Heating an Industrial Plant

BY P. H. FALTER
Vice-President Electric Furnace Construction Company, Philadelphia

THE factory of the Ford Motor Company at Green Island, N. Y., is heated by hot water which in turn is heated by electricity. The building is 1,140 ft. long, 120 ft. wide, and consists of three bays, the two side bays being about 20 ft. in height and the central bay about 35 ft. in height. About 60 per cent of the outer exposure of this building consists of glass. Water is circulated by motor-driven centrifugal pumps at the rate of 1,600 gal. per minute and at a pressure of about 40 lb. The total radiation installed is 65,000 sq.ft. The water is circulated through one or two electric heaters, depending upon weather conditions, and is raised in temperature from 135 deg. F. to about 153 deg. F. The heaters are of the electrode or water-resistance type, having a capacity of 3,200 kw. each, and are operated at 4,600 volts, three-phase, 60 cycles. The electrical input is controlled by the level of the water in the boiler exactly as in the case of a steam generator and independent of the pump pressure. The change of water level is accomplished by an air column in the heaters, the length of which can be varied at will by admitting or releasing air.

The control of power input is, therefore, extremely simple and could be accomplished by thermostatic attachment if desired; but inasmuch as the boilers or heaters operate very steadily and it is only necessary to change the power input according to outdoor temperature, thermostatic control was not thought worth while.

The heaters are specially equipped with baffle plates to prevent the direct passage of cold water through them. Inasmuch as the heaters are installed in the building to be heated, they are not covered. Each heater occupies a floor space only 4 ft. square, and a surge tank occupying an equal amount of floor space is required in order to avoid waste of water when the load on the heaters is reduced; thus only a small amount of water need be added occasionally to make up for leakages from the system.



HIGH EFFICIENCY OBTAINED BY USING ELECTRICALLY HEATED WATER SYSTEM IN INDUSTRIAL PLANT

The advantages of electric heating are cleanliness, minimum of space required and high efficiency. No separate heating plant is required, no fuel storage, ash handling or labor. The heaters require only occasional attention from a janitor or other attendant who also looks after the circulating pumps and performs other duties.

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Third Savings Fund Started by Central Station

THE success of two previous plans for encouraging thrift among employees has led the Public Service Company of Northern Illinois to open a third five-year subscription period of the employees' savings fund following the termination of the second period on December 16. In explaining the purpose of the fund, Britton I. Budd, president, stated that the rules would be identical with those controlling the second fund.

Any employee of the company who has been in continuous service for one year may subscribe to the fund, which yields interest at the rate of 6 per cent compounded semi-annually. Each subscriber will receive the total amount contributed by him, with interest at the above rate and his pro-rata portion of the profits earned by the fund during the five-year subscription period. Unless he elects to take cash, the amount due will be paid in common stock of the company at 65. It is estimated that a subscriber who has paid $300 into the fund will receive $375, which will entitle him to five shares of the company's common stock and $50 in cash. Should an employee need cash, he can borrow from a committee authorized to make such loans.

This employees' saving fund has now been in operation ten years, and has been found to afford employees a simple and profitable means of investing a part of their earnings. The privilege of buying the common stock of the company at $65 when it is selling on the market at approximately $100 per share is being offered as an inducement to employees to become stockholders. The employees paid, up to Dec. 15, 1923, $313,741.76, which yielded interest of $77,859.26, bringing the total up to $391,601.02. There were 1,329 employee subscribers on the books at that time.

Central Stations Join Bakers to Sell Good Toasters

AS A RESULT of conferences between the Appliance Bureau of the New England Division, N. E. L. A., and the New England Bakers' Association the central stations of that section will co-operate actively with the latter organization in a regional "Make toast your breakfast food" campaign, to be started actively soon after New Year's. In one section of the country a toaster campaign was staged by the bakers during which they sold direct to the consumer an inferior toaster for $1.97, thereby defeating their own object of selling more bread because the appliance was a constant source of annoyance to the consumer and led to numerous service calls.

The Appliance Bureau of the New England division has apparently succeeded in forestalling the general sale of flimsy toasters in New England in connection with the national campaign advertising. Central-station companies participating in the New England campaign, which will run from Jan. 14 to Feb. 15, have been requested by the committee to market standard toasters, listing for $8, for $5.95 on receipt of the coupon which the bakers will inclose in bread wrappers during the campaign.

Pension Plan for Utility Employees

A SERVICE annuity plan that will provide pensions for employees retired on reaching certain ages has been put into effect by the Interstate Public Service Company, which operates a number of electric utilities in Indiana, chief among which is the Indianapolis & Louisville traction line. The company now has about 1,145 employees in the 104 cities served.

The plan provides that a man may be retired at the age of sixty-five years with a pension of 2 per cent of his average annual salary, multiplied by the number of years he has been in continuous service, but not to exceed 50 per cent of his last year's salary and not more than $6,000 in any instance. A woman employee may retire at the age of sixty under the same conditions.

On the employee's petition or on that of a supervisor he may be retired at the age of sixty years, and a woman at the age of fifty-five, with a pension of 1½ per cent of the average annual salary multiplied by the number of years of continuous service and not to exceed 40 per cent of the last annual salary. Any employee may be retired, but with each decrease of one year in age there is a decrease of one-tenth in the percentage of multiplication.

The company will make an annual contribution to finance the plan. Administration will be in charge of five persons, three to be appointed from among the officers or employees of the company and the other two to be selected by the employees by direct ballot.

TOASTER CAMPAIGN CHECK

Check for *Two Dollars and Five Cents* $2.05

Good at *Your Electric Light Co.*

If applied to the purchase of standard $8.00 Electric Toasters

SIGN NAME AND ADDRESS BELOW

Good Only Until February 15, 1924

See other side for details and Special Credit Offer

Good only until February 15, 1924

WE ARE cooperating with the Electric Companies in a campaign to sell 50,000 improved standard Electric Toasters regularly selling at $8.00 or more, for $5.95—and with this check we give our customers opportunity to avail themselves of this bargain during the National Toast Campaign.

Present this check to your Electric company and it will be accepted as cash in partial payment on the Toaster you select.

SPECIAL CREDIT OFFER

IF you desire, your electric light company will accept this check and 95 cents cash and deliver the Toaster to you—the balance to be charged at the rate of $1.00 a month on your light bill.

The Full Amount You Pay is Only $5.95.

THIS COUPON IS INCLOSED BY BAKERS WITH EACH LOAF OF BREAD

Standards of Practice for Utility Advertising

TO PUT their advertising and publicity matter on a plane above suspicion of misrepresentation or overstatement, about twenty Michigan utility companies through the Public Utility Advertising Association have pledged themselves to observe certain standards of practice in advertising. The code which was prepared by representatives from various companies in the state is as follows:

1. To consider the interests of the public foremost, and particularly that portion thereof which we serve.
2. To claim no more but, if anything, a little less in our advertising than we can deliver.
3. To refrain from statements in our advertising which, through actual misrepresentation, through ambiguity or through incompleteness, are likely to be misleading to the public or unjust to our competitors.
4. To use every possible means, not only in our own individual advertising, but by association and co-operation, to increase the public confidence in advertised statements.
5. To refrain from attacking competitors in our advertising.
6. To refrain from imposing upon the seller of advertising service unjust, unreasonable and unnecessarily irksome requirements.
7. To furnish to publishers, when requested, technical information which will help them keep reading pages and advertising columns free from misstatements.
8. To refrain from and discourage deceptive or coercive methods in securing free advertising and to do everything possible to aid the publisher to keep his columns free and independent.
9. To require standards for ourselves equal to those we set for others.
10. To stand unequivocally for "truth in advertising."

Utility Tabulates Employee Experience

A RECENT analysis of the employees of the Oklahoma Gas & Electric Company showed that, although the payroll numbered only about 500 persons, the personnel had potential capacities that made it equivalent to 1,332 individuals. This analysis was made to determine what reserve ability within the organization itself could be called into immediate service in an emergency.

Each employee was requested to fill out a qualification card and indicate the various vocations under which he was proficient. If one could qualify, by reason of experience, as a clerk, cashier, bookkeeper, lineman or accountant, he so indicated. About sixty different vocations and trades were listed, ranging from boilermakers, millwrights, mechanical engineers and watchmakers to men professing experience as tool dressers, deputy wardens and prizefighters. With this analysis the management now knows where it can obtain men for the growing needs of various departments and can impress men for special duty in times of emergency.

Manufacturer and Central Station Co-operate in Appliance Sales

AN AGREEMENT between the Worcester (Mass.) Electric Light Company and the Eureka Vacuum Cleaner Company recently went into effect whereby the latter now occupies a store at 270 Main Street, Worcester, under the title "Eureka Vacuum Cleaner Department of the Worcester Electric Light Company," the sale of these cleaners also being handled by the manufacturer at the main office of the Worcester company, 11 Foster Street. O. R. Underhill, manager of the lighting company's appliance department, stated to a representative of the ELECTRICAL WORLD that under the agreement the manufacturer reserves the proceeds of a stated number of cleaner sales each month to cover the operating expenses of the store, all revenue in excess being turned over to the central-station company. The lighting company buys the cleaners from the factory.

At the main office of the central station the vestibule (10 ft. long by 4 ft. wide) has been assigned in part to the vacuum-cleaner company, which makes demonstrations and sales there during regular office hours. The manufacturer furnishes the salespeople in return for the space. Thirty cleaners were sold to the public from this vestibule in the nine days preceding Christmas.

EIGHTY CLEANERS SOLD IN THREE MONTHS IN THIS VESTIBULE "STORE"

Employee Stockholders an Asset to Utilities

COMPANIES which are awake to the problems of creating and maintaining good public relations are realizing the benefits of giving their employees an opportunity to own the company's securities. For example, according to a recent analysis, more than 63 per cent of the employees in the Insull companies are either full-fledged stockholders or are purchasing stock through savings plans. The percentage of employee ownership ran as high as 80.3 in the North West Utilities Company and is 78.8 in the Commonwealth Edison Company and 78.5 in the Central Illinois Public Service Company.

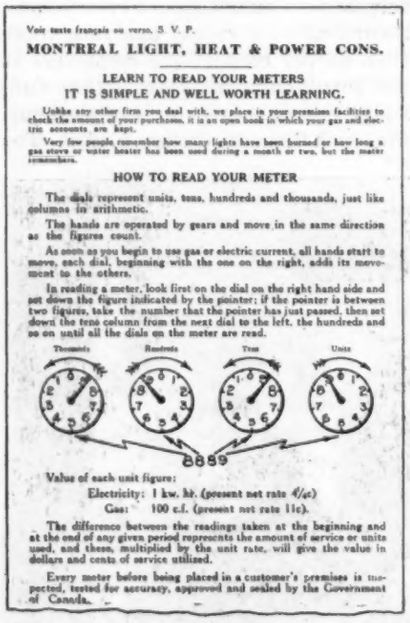
The Chicago *Tribune*, in commenting upon these figures recently, said: "It makes for a large justice in private industry and therefore for a greater efficiency and prosperity. It broadens the knowledge, the interest and the profit of the employee in the enterprise to which he is contributing his efforts."

More than this, the employees have the advantage of knowing from their close association with their company's affairs how it is prospering and what the future may be. As employee-stockholders they receive not only their pay check but have another income through participation in their company's earnings,

consequently they are more likely to be closely interested in the company's financial welfare, its relation with the public and in growing with the company instead of drifting elsewhere.

Instructing Customers to Read Their Meters

EXPERIENCE has shown that comparatively few complaints of high bills come from customers who can read their electric meters and



Voir texte français au verso. S. V. P.

MONTREAL LIGHT, HEAT & POWER CONS.

LEARN TO READ YOUR METERS
IT IS SIMPLE AND WELL WORTH LEARNING.

Unlike any other firm you deal with, we place in your premises facilities to check the amount of your purchases. It is an open book in which your gas and electric accounts are kept.

Very few people remember how many lights have been burned or how long a gas stove or water heater has been used during a month or two, but the meter remembers.

HOW TO READ YOUR METER

The dials represent units, tens, hundreds and thousands, just like columns in arithmetic.

The hands are operated by gears and move in the same direction as the figures count.

As soon as you begin to use gas or electric current, all hands start to move, each dial, beginning with the one on the right, adds its movement to the others.

In reading a meter, look first on the dial on the right hand side and set down the figure indicated by the pointer; if the pointer is between two figures, take the number that the pointer has just passed, then set down the tens column from the next dial to the left, the hundreds and so on until all the dials on the meter are read.

Thousands Hundreds Tens Units

8859

Value of each unit figure:
Electricity: 1 kw. hr. (present net rate 4½c)
Gas: 100 c.f. (present net rate 11c).

The difference between the readings taken at the beginning and at the end of any given period represents the amount of service or units used, and these, multiplied by the unit rate, will give the value in dollars and cents of service utilized.

Every meter before being placed in a customer's premises is inspected, tested for accuracy, approved and sealed by the Government of Canada.

THESE INSTRUCTIONS PRINTED IN BOTH FRENCH AND ENGLISH ARE PLACED NEAR METER

thus check the amount of energy used.

Basing its action on this fact, the Montreal Light, Heat & Power Consolidated of Montreal has endeavored to make it possible for all of its customers to know how to read their meters and compute the amount of electrical energy or gas consumed during a given period.

The card shown here bearing simple, direct instructions for reading a meter dial and figuring the amount of the bill has been hung in a conspicuous place on or near all electric and gas meters. It is 5½ in. by 9 in. in size, and on the reverse side the instructions are printed in French for the benefit of the company's French-speaking customers. It has been found in a number of instances that customers who almost habitually thought their bills too high have ceased to complain after the apparent mystery of meter reading was made clear to them.

Appliances Go by Parcel Post for 7 Cents

A HEATER campaign put on by the Washington Water Power Company during October resulted in the sale of 729 heaters. The heaters were delivered by parcel post at a cost of 7 cents each, whereas the cost by automobile delivery would have been from 35 cents to $1. The sale was limited to the month of October. Post cards with descriptive matter and an order blank were delivered with each customer's bill during that month. A little "tie-in" advertising in the newspapers was used in addition. The heater offered was the 14-in., 600-watt type at the special price of $6.95 cash or on terms if desired. The sale of 729 heaters was deemed a remarkable response as very little personal solicitation was done.

Scholarship Prize Rewards Study of Public Utilities

TO ENCOURAGE interest in the study of the utility business in the public schools the Northwest Electric Light & Power Association has announced a scholarship prize, to be competed for by seniors in the high schools of Washington, and to be awarded each year for the best essay written on the topic "State Regulation of Public Utilities." The scholarship will be a four-year university course in any of the public or accredited private institutions of higher learning in the state and will be in the sum of $250 a year.

What Other Companies Are Doing

El Paso, Texas.—The El Paso Electric Railway Company entertained the members of the Rotary Club at luncheons on Dec. 13 and 20, following which the guests were taken for an inspection trip through the distribution department and the power plant. Approximately 165 Rotarians were entertained at the two luncheons.

Providence, R. I.—A bonus of $1 per share was paid recently to all employees of the Narragansett Electric Lighting Company who had subscribed for employees' stock in 1920 and held it without sale since that time. This is the second bonus so paid by the company on this stock, and bonuses will continue for three more years. About 90 per cent of the employees have held their stock. On a present issue of stock for which payment will be completed during 1924 a bonus of $1 per share will be paid and will continue for five years beginning September 1.

Chicago.—In the belief that investors like to know about the men operating the companies in which they have placed their money, the Utility Securities Company of Chicago is publishing in its monthly house organ short sketches of the executives and department heads in the utilities under the Insull management. In a recent questionnaire sent out to this organization's customers, asking what type of articles appealed to them the most, this section "Men Behind Your Investment" received the greatest number of votes. The biographies have helped materially to liven up the pages of the bulletin, normally containing much solid reading matter.

San Francisco, Cal.—The Pacific Gas & Electric Company has just distributed the first issue of a news pamphlet entitled "P. G. & E. Progress." It is intended to foster better public relations and is designed to afford the company's customers and stockholders a better understanding of what it is doing in power development and to tell what the electrical industry means to the community. The paper will be issued once a month to a mailing list of more than three hundred thousand.

Fitchburg, Mass.—Late December figures from the Fitchburg Gas & Electric Company indicated that during 1923 the company would sell 1,050 electric flatirons, or one for every seven residential customers. An iron is placed on trial with every new customer, and local contractor-dealers have capitalized on this in many cases by merchandising irons when wiring the residences. It is estimated that a total of 1,600 irons have been sold in Fitchburg in the past twelve months, and the residential meter gain has been about 1,400.

Philadelphia, Pa.—The Philadelphia Electric Company has voted a wage dividend to employees for the past year varying from 2 to 8 per cent of total earnings of the individual workers during this time, based upon the length of service with the company. It is expected that the dividend will be paid early in January.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Photostat copies or English translations of complete articles will be furnished at cost upon request

Hydro-Electric Development and Steam Equipment

Field Method for Determining Dissolved Oxygen.—G. A. DE GRAAF.—The writer, being actively concerned with the determination of dissolved oxygen in water and steam, found the available methods of sampling and analysis either unreliable or unsuited for power-plant use. In the article he describes a simplified method and gives the results obtained in tests at a large power station.—*Power*, Dec. 11, 1923.

Factors Affecting Life of Boiler-Setting Refractories.—The Bureau of Standards is conducting an investigation for developing a laboratory slag test in order that factors of composition both of the slag and refractory and their comparative effect on the life of brick may be determined. The apparatus necessary for carrying out such a test has been designed and constructed, and it is proposed to observe the effect of high, medium and low fusing clinker on various brands of refractories.—*Technical News Bulletin No. 80 of the Bureau of Standards.*

The Hydraulic Relations Between Power Stations Along the Same Watercourse.—K. G. LJUNGDAHL.—An investigation is described that was carried out for a specific river system in Sweden, but the method has general interest. The hydraulic system is shown in Fig. 1. The power station at A has a water consumption of q_1. This is delivered to a reservoir having an area Q and a water level h. From this reservoir it flows through the waterfall at B so that the water supply for the power station at C is q_2. It is desired to determine q_2 when q_1 is known. The water consumption at A varies through a complete cycle in twenty-four hours so that q_1 is composed of a constant term and a periodic term. The latter has a fundamental wave with a period of twenty-four hours and certain harmonics of comparatively low amplitudes. It is evident that q_2 will obtain a similar form. The differential equation for the system will be

$$q_1\,dt = q_2\,dt + Q\,dh. \qquad (1)$$

The waterfall at B delivers a certain water volume dependent upon the water level h, so that

$$q_2 = fh. \qquad (2)$$

The function f is usually quite complicated, but for a limited range of the water level it is permissible to make

$$q_2 = a + bh, \qquad (3)$$

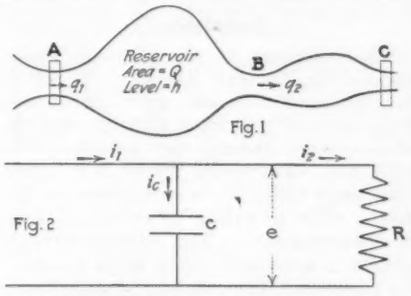
where a and b are constant. If this value of q_2 is introduced into equation (1), one obtains:

$$dh/dt + bh/Q = q_1/Q - a/Q. \qquad (4)$$

With the exception of the last term, this equation is identical with the differential equation for the electric circuit shown in Fig. 2, which is:

$$de/dt + e/RC = i_1/C. \qquad (5)$$

This circuit is treated very conveniently with the common vector diagram when the current i_1 is sinusoidal. The author shows that q_1 in Fig. 1 may be considered as sinusoidal without considerable error. He then discusses the hydraulic problem by the vector method and obtains results which agree very well with actual observations. This paper was read at the Electrotechnical Congress in Gothenburg, Sweden, 1923. —*Teknisk Tidskrift (Sweden), Elektroteknik*, Oct. 6, 1923.



DETERMINING FLOW OF WATER AT THE SECOND OF TWO HYDRO PLANTS ON THE SAME RIVER

Generation, Control, Switching and Protection

Electrical System of Combustion Control for Boiler Plants.—Boilers are described which are automatically controlled by a master regulator at the throttle valve, which adjusts the voltage of the exciter generators connected to the field windings of the stoker, forced-draft and induced-draft fan motors. The application of this master-control equipment to pulverized-coal installations is also described.—*Power*, Jan. 8, 1924.

Eddy Currents in Solid Iron.—E. ROSENBERG.—Calculations of eddy-current losses in solid-iron plates can be simplified by formulas developed by the author. The loss per unit of surface of a solid-iron conductor when traversed by alternating current may be computed very accurately with the same formulas. Special investigations led to a method to determine how deep the eddies enter into the iron. With the aid of these formulas the losses are calculated in the rails of an alternating-current railway as an example. Particular stress is laid, however, on the application of eddy-current losses for the design of brakes, such as may be used to advantage on testing stands for gasoline engines and other prime movers, mine hoists, etc. A detailed description of a large eddy-current brake installed on a 1,400-hp. mine-hoist motor in South Africa is given. The rotor of this brake is a standard forty-pole field wheel of about 12½-ft. diameter. The stator is a large hollow casting of cast iron, surrounding the rotor with an air gap of about ½ in. Water circulates through the stator to keep its temperature within permissible limits. Test results made with this brake with various air gaps, frequencies and speeds agree with the author's formulas.—*Elektrotechnische Zeitschrift*, Dec. 6 and 13, 1923, and *Elektrotechnik und Maschinenbau*, Dec. 9 and 16, 1923.

Transmission, Substations and Distribution

Influence of Salt Air on Porcelain Insulators.—E. SYLWAN.—This article gives a very complete analysis of the mechanical properties of porcelain insulators. Difficulties have been encountered in maintaining the insulating properties of the insulators on the transmission line from the power station at Trollhättan, Sweden. The author shows that the difficulties are mainly due to a deposit of salt on the insulators occurring during and after westerly storms. These deposits are very detrimental, especially during periods of high humidity, when leakage currents and flashovers are the direct results. The location of the transmission line relative to the surrounding terrain is important. Pine woods on the windy side are beneficial because they act as filters. It is also possible to dimension the insulators in such a manner that the salt deposits and their effects are reduced to a minimum.—*Teknisk Tidskrift (Sweden) Elektroteknik*, Nov. 3 and Dec. 1, 1923.

Artificial Transmission Lines with Distributed Constants.—F. S. DELLENBAUGH, JR.—An abstract of this paper may be found in the ELECTRICAL WORLD report of the A. I. E. E. summer convention, July 7, 1923, page 18.—*Journal of A. I. E. E.*, December, 1923.

Units, Measurements and Instruments

Radio Transmission Measurements on Long Wave Lengths.—H. H. BEVERAGE and H. O. PETERSON.—A method of measuring the strength of received signals is described, both as to theory and as to apparatus employed.—*Proceedings of the Institute of Radio Engineers*, December, 1923.

Sensitive Null Voltmeter.—W. GORGAS.—For synchronizing alternating-current machines null voltmeters are being used extensively. The author describes such an instrument, which he claims is ten times more sensitive near the zero point than any other voltmeter. This high sensitiveness is reached by providing a small contact on the shaft of the pointer which short-circuits a series resistance during the first part of the scale. It is thus possible to have on a voltmeter for 220 volts a 10-volt scale taking up one-half of the total scale. Although the sliding contact has to make or break only from 2 volt-amperes to 13 volt-amperes, its presence on a delicate

measuring instrument is something so unusual that it is difficult to see its permanent advantage. — *Elektrotechnische Zeitschrift*, Nov. 15, 1923.

Illumination

Hospital Operating-Room Lighting with Reproduced Daylight.—NORMAN MACBETH.—A description is given of an artificial daylighting equipment by which the demands of surgeons have been satisfactorily met. The mechanical equipment is installed in two operating rooms. The light is multidirectional toward the center of the rooms following a scheme of localized general illumination. None of the equipment is below the ceiling and none of it is directly over the table, thus obviating the dust and radiant heat which are present with the usual operating-table luminaire.—*Transactions of I. E. S.*, November, 1923.

Motors and Control

Motor Maintenance and Repair.—In this issue of the *Electric Journal* appear fifteen articles discussing the methods of repairing motors which have been determined as most suitable through many years of practical experience. If repair parts are carefully selected and the work done in a thorough manner, the first cost of such work can be made a comparatively small item. Also, if the operating conditions are controlled so as to take full advantage of the inherent superiority of the rotating machine, the electric motor becomes a very reliable piece of apparatus.—*Electric Journal*, December, 1923.

Strip Mill Designed for Ease of Control.—A 20-16-in. strip mill has recently been placed in operation by the West Leechburg Steel Company, Leechburg, Pa. This mill is designed to roll strips from 18 in. to 6 in. in width and ¼ in. and lighter in thickness in either coiled or cut lengths. The arrangement of the various stands and the completeness of motor drive are features of this installation.—*Iron Age*, Dec. 13, 1923.

Heat Applications and Material Handling

Three-Phase Hoisting Apparatus.—D. I. JANZEN.—Two electrically driven three-phase mine hoists were supplied from a power house the output of which was barely sufficient to cover their widely fluctuating load. Rather than go to the expense of elaborate machinery, a flywheel buffer set was installed which has completely eliminated the previous voltage variations, keeping the load on the power house uniform. The set consists of a three-phase induction motor and a three-phase commutator motor arranged on the sides of a 4-ton flywheel. To obtain sufficient flywheel action the speed of the set may vary from 15 per cent below to 15 per cent above the synchronous speed of 750 r.p.m. An unusual automatic drive was developed to take care of the shifting of the two heavy brush yokes required on the set. The paper gives a detailed description of this device. The flywheel set itself requires for its drive 14 per cent of the output of the power house.—*Siemens Zeitschrift*, November, 1923.

Arc-Welded Rail Bonds.—Two articles in this issue discuss the development of arc-welding bonds to steel rails. C. F. Gailor analyzes this development and discusses the character of bonds, use of molds, various welding processes and mechanical, electrical and miscellaneous tests. H. H. Febrey considers the make-up of various bonds with a description of the part comprising the bond. — *Journal of American Welding Society*, December, 1923.

Traction

Electrification of the Mexican Railway.—The Mexican Railway Company has commenced work upon the electrification of the most difficult section of its system, namely, that between Orizaba and Esperanza, where the track rises over 4,000 ft. in a distance of 29 miles, with a ruling gradient of one in twenty-four. The direct-current system is used with 3,000 volts as trolley potential. The catenary span, cross-span and bracket construction for double trolley wire are described. The major part of the article is taken up with a discussion of the problem of handling various train loads over the steep gradient. — *Electrical Review (England)*, Dec. 21, 1923.

Automatic Train-Control Installation Completed.—The Chicago, Rock Island & Pacific is the first railroad to have a complete installation of automatic train control. The installation consists of an automatic train-control device of the intermittent electrical contact type. This was first placed in operation in March, 1920, between Blue Island and Joliet, Ill., a distance of 22.6 miles of double-track road. The installation now consists of twenty equipped locomotives with thirty-four roadside ramps operating in connection with thirty-two automatic signals. An outline of the method of operation under the system as installed is described.—*Railway Review*, Dec. 22, 1923, and *Railway Age*, Dec. 22, 1923.

Electrophysics, Electrochemistry and Batteries

Influence of Gaseous Ionization and Spark Discharge on Fibrous Insulating Materials and on Mica.—J. B. WHITEHEAD.—The influence of ionization and spark discharge on mica is studied qualitatively in some detail, and the results indicate that mica is practically immune from uniform layers of ionization in a thin air film. The most dangerous condition for mica is a spark discharge playing over its surface. Such sparks fasten on any surface flaws, leading to splintering and ultimate breakdown. The worst condition for mica is the presence of an isolated discharge point on one side in relation to a fairly wide conducting area on the other side of the insulation containing the mica. Under such circumstances mica is completely disintegrated within a short time at voltages in the neighborhood of 50 kv. with air gaps in the neighborhood of 9.5 mm.—*Journal of A. I. E. E.*, December, 1923.

Telegraphy, Telephony, Radio and Signals

Recent Developments in Carrier-Current Communication.—L. F. FULLER.—An abstract of this paper may be found in the ELECTRICAL WORLD report of the A. I. E. E. Pacific Coast Convention, Oct. 20, 1923, page 805.—*Journal of A. I. E. E.*, December, 1923.

Application of Statistical Analysis to Radio.—One of the problems which have confronted the radio laboratory of the Bureau of Standards is the analysis of a large number of complex data obtained in its investigations of radio transmission phenomena. Such an analysis of the investigation of signal fading has recently been completed, using the calculating machines of the Bureau of Census.—*Letter Circular 105 of Bureau of Standards.*

Commercial Radio-Tube Transmitters.—W. R. G. BAKER.—In this sixty-page article the author considers the various types of commercial transmitting equipment classified according to power rating, service requirements, circuit design, etc. Tube transmitters for outputs of from 0.5 kw. to 20 kw. and for continuous-wave and interrupted continuous-wave telegraphy and telephony are described in detail. The essential elements of such transmitters are discussed, and data are given on the characteristics of various power tubes and rectifiers, together with a statement relative to the expectation of tube life.—*Proceedings of the Institute of Radio Engineers*, December, 1923.

Miscellaneous

Electric Heating in Home and Industry.—F. JORDAN, W. KRUG and D. SCHNEIDER. — A number of water-storage heaters operated electrically for use in households and in creameries and other industrial establishments are described and illustrated. Tabulations are given, with data gained from actual service, to show the time and power consumption for instantaneous heaters and storage heaters. Modern designs of both these types reach an efficiency of 90 per cent and more. In industrial plants with their own power supply a large storage heater or a well-lagged electric steam boiler so equipped that it consumes automatically only surplus energy and stores it in the shape of hot water or steam may be installed to great advantage. If so desired, a perfectly straight horizontal total load curve of the station may thus be obtained, insuring a constant operation of the generators at their best efficiency.—*Elektrische Betrieb*, Dec. 10, 1923.

Cooling of Electric Machines.—G. E. LUKE.—An abstract of this paper can be found in the ELECTRICAL WORLD report of the A. I. E. E. summer convention, July 7, 1923, page 16.—*Journal of A. I. E. E.*, December, 1923.

Scientific and Industrial Research

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available and Suggestions for Co-operative Work

Conducted by PROF. VLADIMIR KARAPETOFF, *Cornell University, Ithaca, N.Y.*

[PRINTED IN THE THIRD ISSUE OF EACH MONTH]

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

Research Completed

Generator, Turbo, Closed Ventilation of

An important development in auxiliary equipment made during the past year consists of a closed system of generator ventilation in connection with a 15,000-kw. turbo-generator. The equipment is made up of surface coolers, through which the condensate is circulated. The results obtained in regular operation are up to expectations and very satisfactory. This type of installation minimizes the damage which might result from a generator fire, reduces to a minimum the accumulation of dirt on the generator windings and also conserves a large part of the generator heat losses. This equipment is being quite generally accepted for large units.—*Proceedings Association of Iron and Steel Electrical Engineers*, 1923, Vol. 5, page 490.

Pumps, Centrifugal, in Steel Plants

Actual experiments show that where electric power is available there is no comparison between the electric motor and gas or steam-engine drive for centrifugal pumps. With electric drive the first cost, maintenance and attendance are considerably less, and the simplicity and the reliability are much superior; the power cost is from 25 to 50 per cent less. (For details see *Proceedings Association of Iron and Steel Electrical Engineers*, 1923, Vol. 5, page 309.)—*B. A. Cornwell, Youngstown, Ohio.*

Photometer, Integrating, Icosahedron Shape

An icosahedron surface has been successfully used for the measurement of the very largest of street-lighting luminaires. Such a solid, having twenty equilateral triangular faces, is more adapted to manufacturing and occupies less vertical distance than a sphere, without sacrificing any accuracy within the limits of commercial testing.—*Westinghouse Lamp Company, New York City.*

Steel Mill Drive, Polyphase Brush-Shifting Motor for

At the Holcomb Steel Company's plant in Syracuse, N. Y., polyphase brush-shifting alternating-current motors are used for some main-roll drives. This is the first installation applied to mill drives. Speed control is obtained by two sets of brushes, whose relative position on the commutator is altered by means of a motor-operated brush-shifting mechanism. This motor has characteristics practically identical with those of the double-range Scherbius equipment and fills a long-felt want for an adjustable-speed alternating-current drive where the power required is too small to make Scherbius or Kraemer apparatus feasible on account of the high initial cost.

Steel Mills, Main-Roll Drive

For main-roll equipment the use of 60-cycle power practically means a gear reduction, and here is seen one great development which has required several years to accomplish. At one time a gear reduction on a main rolling mill drive was a questionable point, but now this form of drive has become entirely reliable. In many cases the flywheel is directly mounted on the motor shaft, and the gear reduction therefore, has to stand severe shocks of rolling. Even these equipments have given good service, and, therefore, the success of the gear drive has really helped to a large extent to increase the number of motor applications through the use of purchased 60-cycle power.—*W. C. Kennedy, Claymont, Del.*

[This development promises to be of great importance in that it will enable steel mills to purchase 60-cycle power on a much larger scale and also to interchange power with public utilities.—EDITOR.]

Thermopiles, Sensitive and Rapid

In accordance with Dr. Moll's principles, we have developed new thermopiles, in which the heat storage capacity of the active junctions has been reduced to a minimum and that of the passive or cold junctions made as great as possible. As a result both the sensitivity and the rapidity of indication have been greatly increased.—*P. J. Kipp & Zonen, Delft, Holland.*

Wattmeter, Totalizing Recording

In the familiar relay-type curve-drawing wattmeter several measuring elements are provided (from two to twelve, of the Kelvin balance type), each connected to an independent circuit. The elements are all mechanically connected to one set of contacts, so that it is the total pull of all the elements that closes or opens the contacts. In this manner the power of from two to twelve independent circuits can be totalized and the sum recorded on one chart.—*Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.*

In Progress or Purposed

Audion Valves

The possibility of testing the life of vacuum valves by means of forced life tests is being investigated. The question of the possibility of an all-metal transmitting valve is also receiving attention, and tests have been made to ascertain to what extent a high vacuum may be maintained in a phosphor-bronze tube heated in an electric furnace.—*National Physical Laboratory, London, England.*

Coal, Briquetting of

New experimental vertical retorts, based on Scottish shale-oil practice, have been erected with a view to low-temperature carbonization on a commercial scale. It is proposed to briquette a blend of coking and non-coking coals by raising them to a temperature below the decomposition point and then subjecting them to pressure without any added binder. The briquettes will then be carbonized in the new retorts.—*Fuel Research Board, London, England.*

Fans, Electric, Rapid Testing of

The usual test of the air delivery of electric fans is very unsatisfactory, because it takes considerable time, and the results cannot be repeated with accuracy. It is believed that these objections have been overcome in the device now being worked out, the principle of which was tried and found workable some time ago. The present work is directed toward applying this principle in a more convenient form for field use.—*Bureau of Standards, Washington, D. C.*

Power Alcohol

Considerable research is being done on the fermentation of cellulosic materials for producing alcohol for power purposes on a large scale. The British colonies have assisted materially in this investigation with a view to utilization of waste products. The following materials have been so far investigated: wheat-straw, African grasses, sweet potatoes, waste molasses, flax, cassava and nipah-palm.—*Department of Scientific and Industrial Research, London S. W. 1, England.*

Vision, Speed of

One of the factors in the increase of industrial production due to improved lighting is the speed of visual impression, that is, the interval of time which it takes a person to recognize the form, the color or merely the presence of a certain object. Extensive tests on the subject are being made in the Nela Research Laboratories in Cleveland, Ohio. Among the first results, reported at the 1923 annual convention of the Illuminating Engineering Society, is that the speed of visual impression (under certain specified conditions) due to a test object rising out of a clear field is increased by a constant amount each time the brightness is increased by a constant factor.

Suggestions for Research

Case Hardening, Electrolytic Coppering for

In case-hardening metal pieces it is sometimes necessary to keep certain parts soft and to protect them while in the oven. Barattini (*Elettrotecnica*, 1923, Vol. 10, page 222) recommends electrolytic coppering of areas not to be hardened, and as this process may be of considerable importance in the motor-car industry, further studies of this proposal are desired.

Converter Substations, Noise and Vibration in

Considerable research work on the elimination of noise in buildings and on the companion trouble of vibration has been done by the engineering experiment station of the University of Illinois. While this work was undertaken more in connection with acoustic properties of buildings of other types, it is probable that basic principles have been established which may be of value in connection with the study of converting apparatus already in service and with the elimination of its objectionable features for the neighborhood.

Distribution, Three-Phase, 220-110 Volt

In some localities it is desirable to connect 220-volt, three-phase motors and 110-volt lamps to the same circuit. Under such conditions it is usually required to have the middle point of the 220-volt transformer winding grounded, so as to prevent the lamp user from coming in contact with potentials of over 110 volts. With the usual transformer connections the middle point of only one phase can be grounded, which means that all lamps have to be connected to that phase. It is desired to develop a system of 220-volt, three-phase connections with which 110-volt lamps could be distributed in all the phases and the lamp user could not get over 110 volts even under abnormal conditions.

[A compromise solution is to connect 125-volt transformer secondaries in Y, with the neutral grounded, and to use 125-volt lamps. The motor voltage is then $125 \times 1.73 = 216$ volts, which is near enough to 220 volts.—EDITOR.]

Rotary Converter, Protection of

A manufacturer recommends for the protection of converters the rheostatic control of the commutating field, responsive within a very few cycles; also the addition of high-reluctance field windings. He depends further upon the design characteristics of his machine for self-protection against destructive action of excessive overloads. Another manufacturer makes definite announcement of the availability of a commercial type of high-speed breaker which will make possible the effective use of shunted resistance in the armature circuit within a time interval sufficient fully to protect the converter and limit the drain on the system. This same manufacturer recommends the use of a separate exciter for increased regulation range and protection against excessive overload. One operating company has under consideration tests looking toward the definite evaluation of some of the constants underlying converter self-protection.

Three-phase Installations, Protection of, Against Unsymmetrical Line Voltages

A three-phase unloaded induction machine connected in series with the line and driven mechanically against its revolving field, at a slip of 200 per cent, offers a comparatively low impedance to currents of direct phase sequence and quite a high impedance to those of inverse sequence. It should therefore keep the latter out of the installation and help to keep the voltages balanced. (For details see *Elektrotechnische Zeitschrift*, 1923, Vol. 39.)—*E. Zachrisson, Vesteras, Sweden.*

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Muscle Shoals Hearings Resumed

Various Bills Taken Up by the House Military Affairs Committee—Senators and Farm Bureau Federation Representative Attack Alabama Power Company

HEARINGS have been resumed in Washington before the House military affairs committee on the various bills which seek to dispose of the government's war-time nitrate and power projects at Muscle Shoals, Ala. The principal feature at the opening of the hearings was the view taken by Representative J. Mayhew Wainwright of New York, a new member of Congress and of the committee, but a former Assistant Secretary of War and familiar with the War Department point of view. He announced at the hearings that new bids should be asked for, to obtain the highest possible offer and best guarantees, and he proposed that a sub-committee of the military affairs committee should be named to confer with the President in regard to the President's recommendations in his message advising the appointment of a small committee or joint commission, under general legislation, to deal with Muscle Shoals.

Madden and Garrett for Ford

Representative Madden of Illinois, chairman of the House appropriations committee, was heard on his bill and advocated the acceptance of the so-called Ford offer. Giving figures he used in a speech made by him last year, he recited the tremendous sums spent and to be spent by the government; denounced the idea of government ownership and operation, and made it plain he desires Congress to get rid of Muscle Shoals, preferably to Henry Ford. Representative Garrett of Tennessee, the Democratic leader of the House, was also heard. He declared for the so-called Ford offer on the ground of aiding the farmer with cheap fertilizer.

It developed at the opening of the hearings that nothing has been heard by members of Congress from Mr. Ford in any authoritative way as to whether he still wants Muscle Shoals or whether he would accept any of the bills now before Congress. Representative McKenzie of Illinois has been trying to obtain some statement from Mr. Ford on this subject. Mr. McKenzie's bill, now before the committee, is a pro-Ford bill, but he is frankly anxious to have the Ford representatives say if his measure is satisfactory before he tries to report it out.

Thomas W. Martin, president of the Alabama Power Company, and representatives of a group of other Southern power companies were present at the hearings, prepared to testify, if desired, upon the joint letter they recently sent to the Federal Power Commission on the initiative of Representative Harry E. Hull of Iowa. They will be heard by the committee.

The committee will also go into the bill introduced by Representative Dickinson of Iowa, a member of the House steering committee and the leader in the House of the farm bloc, which would place Muscle Shoals under the federal water-power act irrespective of who leases or buys the plants and water-power rights. One of those to be heard on this bill, in addition to O. C. Merrill, executive secretary of the Federal Power Commission, will be Dr. Cottrell of the fixed-nitrogen research laboratory of the Department of Agriculture, who will be heard at the request of the Secretary of Agriculture.

A group of men from Seattle and St. Louis have asked for hearings in behalf of the newly organized Pacific Nitrogen Company. It is also understood that the Secretary of War hopes soon to send to the Congress a fertilizer offer from the Union Carbide Company and an offer to manufacture fertilizer by using the 100,000 hp. to be reserved for that purpose by the offer of the associated Southern power companies made public last week.

Alabama Power Company Attacked

As the hearings began in the House committee Senator McKellar of Tennessee and Senator Heflin of Alabama, both pro-Ford and both anti-Alabama Power Company, delivered on the floor of the Senate an attack on that company, charging that its securities are 70 per cent British-owned. They maintained that such a situation would be dangerous to the United States in time of war and that it would be unwise to turn Muscle Shoals over to any one except Henry Ford without requiring that the ownership of any corporation operating Muscle Shoals should remain American. Senator McKellar and Senator Heflin were answered by Senator Norris of Nebraska, chairman of the Senate committee on agriculture and forestry, who apparently has not altered his opposition to the Ford proposals made evident in the last Congress.

Coincidentally, speakers at the annual meeting of the Public Ownership League, which was being held in Washington, delivered similar attacks on the Alabama Power Company, and Gray Silver, Washington legislative representative of the American Farm Bureau Federation, made public various statements and letters supporting the so-called Ford offer and attacking the company and also Secretary Weeks for selling the Gorgas plant to it. Representative Wainwright during the hearings characterized the Silver attack as insulting to Secretary Weeks and untrue.

A New Proposal

Another offer for the development of the Muscle Shoals properties by private capital was received on Wednesday by Secretary Weeks from sources which the Secretary declined to reveal but which he characterized as financially reliable. The Secretary also refused to discuss details of the new proposal, explaining that he would have a study made by engineer and ordnance experts and later would decide what action might be taken by the department. Secretary Weeks announced the receipt of the proposal after he had conferred briefly with Elon H. Hooker. Mr. Hooker is president of the Hooker Electrochemical Company of Niagara Falls and is said to have discussed Muscle Shoals questions with Mr. Weeks recently.

Bill for Public Ownership

One Is Launched in Washington Setting Up Federal Commission with Extensive Powers

A MEETING of the Public Ownership League of America was held in Washington at the Hotel Hamilton on January 16 and 17, at which a bill to create a national public superpower system which would take over many activities of the government was launched. The bill would create the Federal Public Service Commission, would provide it with the use of a United States bond issue of $500,000,000, would absorb the activities and authority of the Federal Power Commission and the Reclamation Service, and would bring under the control of the proposed commission many other activities relating to oil, gas, fuel, railroads and so forth. Electrical energy, fertilizer and other things would be furnished to consumers at cost. The

Muscle Shoals hydro-electric and steam plants and plants for the manufacture of nitrates would be turned over to the commission for operation.

Notwithstanding the fact that the program included a formidable list of prominent persons as speakers, there were only seven persons at the opening session in addition to newspaper correspondents. Senator Norris of Nebraska, chairman of the Senate committee on agriculture and forestry, made the opening address and spoke in general terms on his conception of the necessity for government ownership and operation in connection with the development of a national superpower system.

Newspaper accounts published in advance of the meeting announced that Senator Norris would introduce the bill which was made public at the meeting, but he did not say so at the meeting.

An analysis of the bill, made public at the meeting of the league, shows that, in addition to the provisions already stated, it covers the co-ordination of irrigation, flood control, navigation and hydro-electric power production; the enlargement and expansion of the Reclamation Service in the field of agriculture, home building and electric power service; superpower service at cost, and federal aid to states, cities and smaller political subdivisions. The system would be under the direction of an independent and permanent commission of three persons to be appointed by the President of the United States with the approval of the Senate, subject to recall by joint action of both houses of Congress.

Southern Power Rates Up

Industrial Users to Pay 10 per Cent More—Building of Two 40,000-Hp. Plants to Begin

THE North Carolina Corporation Commission has just announced the granting of the petition of the Southern Power Company for an increase in rates for hydro-electric power, the increase to apply to industrial users of power but not to municipalities. The increase amounts to about 10 per cent, the rate being raised from 1.25 cents per kilowatt-hour to 1.40 cents. Immediately following this announcement from Raleigh the Southern Power Company announced from its offices at Charlotte that it would begin at once the construction of two 40,000-hp. plants, one hydro-electric and one steam.

The new rate announced by the corporation commission becomes effective Feb. 1. The rate begins at 1.40 cents per kilowatt-hour and grades down for quantity consumption to 1 cent. The increased schedule affects primarily the cotton-mill consumers of North Carolina. The commission finds that under the old rate, now superseded, the company would have earned this year on its investment 4.436 per cent. Under the new rate it finds that the earnings will amount to 6.86 per cent. The increase was resisted by about twenty cotton mills of the state. Whether they will carry their fight to the courts or not has not been determined.

The immediate construction program of the Southern Power Company includes the erection of a hydro-electric plant at Rhodhiss, on the Catawba River, in North Carolina, to develop 40,000 hp. and to cost about $3,000,000, and the erection of a steam plant at Duncan, S. C., also to develop 40,000 hp., and to cost about $2,000,000. Plans already have been drawn for these two plants, and work will begin as soon as possible.

Ford Offers to Supply Power to Detroit

It is reported from Detroit that Henry Ford has offered to supply that city with most if not all of its electric power requirements as soon as his River Rouge power plant is completed, which will be in two and a half to three years. The city has voted to spend $12,000,000 to build a power plant, but Mr. Ford is said to have expressed the opinion that he could sell power to Detroit at less cost than the city could produce its own. Completion of the municipal plant has been postponed from July 1, 1925, to the end of 1926.

Joint Committee to Reorganize

The first meeting of the Joint Committee for Business Development since the election of Milan R. Bump as chairman last September was held at the headquarters of the National Electric Light Association on January 11. This was in the nature of a special meeting to which were invited representatives of the national group associations of the electrical industry and others.

The meeting was devoted to the discussion of the place of the Joint Committee in the industry and the possibilities for its reorganization as a policy committee composed of the officials of the organized group associations to function as a common meeting place for the consideration of broad questions of policy affecting the various branches of the industry. It was decided to appoint a plan and scope committee to make a thorough study of the situation.

Standard for Pressure Treatment of Poles Drawn

The American Wood Preservers' Association, meeting at the Hotel Muehlebach, Kansas City, this week, took further steps toward the adoption of a standard specification for the pressure treatment of poles and other timber. This specification will be submitted to the overhead systems committee of the N. E. L. A. for consideration in the hope it will be adopted at the next national convention of that body and sponsored by it before the American Engineering Standards Committee. The Forest Products Laboratory at Madison, Wis., rendered valuable assistance in developing this pole specification.

"Giant Survey" Outlined

Fuel Economy, Interconnection and Transportation Are Also Topics of Philadelphia Engineers

THREE sessions on fuel economy were held by the Engineers' Club in Philadelphia on January 15 at which prominent engineers and industrial leaders presented papers. Transportation was the topic at the morning session, when the participants were Prof. E. C. Schmidt, G. M. Basford, W. G. Bessler, R. M. Smith and J. Keller. In the afternoon Morris L. Cooke discussed the "Giant Power Survey" of Pennsylvania and told of its development and objectives. As outlined by Mr. Cooke, Pennsylvania has passed legislation to help power developments as follows: (1) An act establishing a joint commission with New York and New Jersey to study the development of the Delaware; (2) an act providing for the issuance of water-power permits based on the principle of the federal water-power act, including recapture clauses and authority to condemn property for storage and circulating water; (3) an act providing that those who participate in water-power developments shall share in the total cost; (4) an act providing for the leasing of water powers on state lands, and (5) an act providing for the Giant Power Survey. He outlined the objectives of the survey as: (1) Building of large steam stations of not less than 600,000 hp.; (2) locating these stations at or near the mines; (3) putting all energy generated into a 220,000-volt state-wide transmission system; (4) the practice of by-product recovery in power production; (5) integration of power systems to secure maximum advantages from interconnection; (6) providing abundant power to small users, particularly the farmers; (7) railroad electrification after a national transportation policy has been determined. Some of these objectives are somewhat ideal, and how far to go in bringing them about will be determined by the survey.

N. G. Reinicker dealt ably with the economies and operating advantages of interconnection, basing his views on experiences with a system having thirteen plants ranging in size from 500 kva. to 85,000 kva., with a total generating capacity of 217,000 kva. He declared that to realize the full advantages it was absolutely necessary to have a system-control force independent of operating routine. This force should have authority to carry out in practice the conclusions arrived at.

Other speakers advocated the interconnection of central-station and industrial plants having process steam requirements to secure mutual benefits. Papers dealing with fuel economies in several industries were read, and in the evening an animated discussion was held on the subject of domestic heating. The keynote of the meeting was that careful attention to firing based on accurate knowledge of combustion would result in immense savings. Professor Fernald presided.

Engineering Council Alters Names

Its Title Transferred to the Federated American Engineering Societies, That Designation Dropped and Council's Present Functions Vested in Assembly

A CONSTITUTIONAL change of importance was made at last week's Washington meeting of the American Engineering Council of the Federated American Engineering Societies, when it was determined that the name American Engineering Council shall henceforth be applied to what is now the Federated American Engineering Societies, the latter title being dropped; that the American Engineering Council as it now exists shall be known as the "Assembly," and that the executive board in future shall be the administrative board. These changes are in nomenclature, not in function, and are in the direction of simplification and the prevention of confusion.

As announced in the ELECTRICAL WORLD last week, ex-Governor James Hartness of Vermont was elected president of the council in succession to Dean M. E. Cooley of Michigan University. Two vice-presidents were elected—L. P. Alford of New York for two years and Charles R. Gow of Boston for one year. The vice-presidents holding over are Calvert Townley of New York and Gardner S. Williams of Ann Arbor, Mich. Dr. H. E. Howe of Washington was re-elected treasurer, and L. W. Wallace of Washington was again chosen executive secretary.

The council on January 11 formally adopted the resolution approved earlier in the week by the public works conference, as already stated in these columns, favoring the reorganization of the federal departments, particularly in reference to the grouping of public works functions in a renamed existing department. This action presages a renewed concerted effort by the council to unify activities in connection with public works.

One of the resolutions adopted declared that a further engineering investigation should be made of the Great Lakes-St. Lawrence waterway before a final decision is made in regard to that project. The council decided to retain representation on the national board of jurisdictional awards. Full co-operation was pledged the War Department, in response to the personal invitation of the Assistant Secretary of that department, in carrying out the plan for industrial preparedness. The council formally gave assurances to the Italian Ambassador that it would assist in placing the 150 Italian graduate engineers who are coming to this country to supplement their college course with a period of practical work in American industry.

DEAN COOLEY EXHORTS ENGINEERS

In his farewell address Dean Cooley said that the progress of industry and social wellbeing were so intimately bound up with engineering that this profession could no longer be held back.

Executive Secretary Wallace said that the council has been growing in public confidence and that its opportunities are great. "It is my conviction," he said, "that the public is in the frame of mind to accept the leadership of the engineering profession and that it has been gratified to note evidences of an inclination on the part of the profession to assert a certain degree of leadership."

Following the meeting, President Hartness held conferences with officers and members of the council at which an active program for 1924 was mapped out.

Kentucky Utilities Men Meet at Louisville

The seventh annual meeting of the Kentucky Association of Public Utilities was held in Louisville on January 10, and many live topics were discussed. On the previous evening a dinner was given to the delegates by the public utilities of Louisville.

President W. H. Harton, in his official address, said that the public has just begun to realize that the utility cannot render service without money. To get this it must go into the competitive market and show good credit, which requires fair rates. Mr. Harton urged co-operation between the Kentucky Utilities Association and the Associated Industries of Kentucky and dwelt on the importance of cities and utilities working together.

Mrs. Florence A. Tait, chairman of the women's public utility committee of the East Central Division of the N. E. L. A., and Miss E. R. McKee, chairman of the national women's committee on public utility information, spoke of the work of these committees. Twelve divisions are now fully organized and more than 15,000 women have attended the meetings. Addresses have been given before luncheon clubs, churches, schools, etc., and the women have also been active in selling utility securities and electrical merchandise.

Richard Bean, president of the Louisville National Bank, entertained his hearers with financial parables.

Frank B. Jordan, secretary of the Indianapolis Water Company, urged utilities to popularize their service in the same way that commercial firms do. He urged that appropriations for 1924 newspaper advertising be made immediately. Public schools also afford an excellent channel through which to popularize utility service. By co-operation twenty-minute motion-picture films can be prepared for exhibition in each community. He advised posting large signs along every street which is torn up for extension work calling attention to the necessity for the work and even indicating the cost.

J. Robert Kelley, president of the Associated Industries of Kentucky, spoke on the opportunity for co-operation between the utilities and the manufacturers' associations. By such co-operation objectionable legislation can be minimized.

M. F. Hosea of the Indiana Telephone Association urged more use of the newspapers; the benefits of conventions to men in the ranks were effectively and concisely stated by G. B. Powell, assistant general superintendent of the Louisville Railway Company, and the work of the National Safety Conference was presented by F. F. Gilmore, Jr., manager of the Louisville Safety Council.

President Johnson Supports Local Electrical Leagues

Speaking at a luncheon of the New York Electrical League held on January 10, President Walter H. Johnson of the National Electric Light Association gave his strong indorsement to the movement to establish local electrical leagues in cities all over the country. There is no industry, he said, that demands a greater degree of co-operation than is necessary among central-station men, manufacturers, contractors and dealers if the electrical industry is to be made efficient. Individual problems may vary in character and degree and must be solved in the way that seems best and most practicable, yet all electrical men are in the one big business of serving the public, and that can best be done through co-operation.

Indiana Utility Men Give Views on Many Problems

Maintenance of the sympathy and co-operation of the people by "suitable publicity and intelligent service" was the keynote struck in the papers presented at the Indiana Public Utility Association's meeting at Purdue University, Lafayette, January 15 and 16. Dean A. A. Potter of the engineering college welcomed the delegates, Prof. W. K. Hatt discussed transportation problems, and Leonard Fitzgerald, president of the Indiana Gas Association, and Frank Carroll of the Indianapolis *News* spoke on publicity, the former urging especially that facts be carried to foreign settlements with communistic sentiments.

The possibilities for extended use of electricity in homes and industry were pointed out by Frank J. Haas of Evansville, president of the Indiana Electric Light Association, who gave a brief review of recent accomplishments in the electrical field. Electrolysis problems were dealt with by Prof. D. D. Ewing, who explained preventive measures. Prof. S. A. Young discussed smokeless combustion. Prof. C. Francis Harding, head of the school of electrical engineering, described the development of insulation problems and emphasized the vital necessity for research along this line.

New Chattahoochee Plant to Cost $5,000,000

The plans for the construction of the dam and hydro-electric plant near Columbus, Ga., on the Chattahoochee River, referred to in the Federal Power Commission news last week as filed by Stone & Webster for the Columbus Electric & Power Company, call for the expenditure of $5,000,000, according to R. M. Harding, local manager of the company. The dam and power plant are to be erected at Bartlett's Ferry, 16 miles north of Columbus and 5 miles north of the present power plant at Goat Rock. The dam will be 120 ft. long, and the initial installation will include two units of 12,000 kw. each, the ultimate installation to be five such units. The plant will provide between 30,000 kw. and 35,000 kw. of primary power, the remainder being secondary power.

A. T. & T. Additions in 1924 to Cost $270,000,000

The American Telephone & Telegraph Company will break all records this year for telephone service expenditures throughout the country. The construction budget of the Bell System just made public calls for the expenditure for net additions to plant of approximately $270,000,000, an increase of $30,000,000 over the 1923 budget.

According to the company, the present year's additions have been made necessary by the continued increase in demand for telephone service. With the 1924 budget included, the American Telephone & Telegraph Company will have spent $1,989,331,300 in meeting this demand for service since 1903.

Three-Year Program of P. G. & E. to Reach $50,000,000

The improvement program of the Pacific Gas & Electric Company calls for the expenditure of more than $50,000,000 in new construction within the next three years, according to a preliminary announcement just made by Vice-president A. F. Hockenbeamer. "For some years to come," he said, "capital expenditures will certainly be at no less a rate than during the past three years."

Another 130,000-Kw. Unit for Milwaukee

With the completion by the Milwaukee Electric Railway & Light Company of the installation at its Lakeside power plant of a new generating unit costing approximately $750,000, increasing from 70,000 kw. to 100,000 kw. the capacity of the plant, comes the additional announcement that another turbo-generator, the fifth, will be installed and placed in operation by December 1 of this year, bringing the total installed capacity of the plant up to 130,000 kw.

The company's building program, more than half of which has already been completed, will ultimately reach a total installed capacity of 200,000 kw., virtually doubling the electrical output of the plant in a few years.

Double Service Capacity

This Will Be Realized in 1924 Program Put Forth by Georgia Railway & Power Company

THE Georgia Railway & Power Company, which last year appropriated more than $6,500,000 for water-power developments, additions and improvements (see ELECTRICAL WORLD, January 27, 1923, page 234), has this year announced that it will spend an equal or possibly greater amount for the same purposes. Both years' expenditures make up part of a twenty-million-dollar program covering the four years ending December, 1926, and destined more than to double the company's former capacity.

Details of the plans for 1924 show that more than half of this year's appropriation will be spent in the Tallulah Falls district in north Georgia, and officials of the company assert that $3,358,000 is to be used in pushing to completion the various hydro-electric projects in that section.

The first step in the 1924 program was made by taking over the plant and distribution system of the Wofford Shoals Light & Power Company. This district will be organized as the "Cornelia District" of the power company, and will have district headquarters at Cornelia.

The second big step will be taken with the completion some time in January of the new dam and power plant 3½ miles below the Tugaloo plant on the Tugaloo River. This plant, which will be known as the Yonah plant, will when it is completed add 88,000 hp. of electrical energy to the company's output.

The third step will be the completion of a mile-long tunnel drilled through a mountain of solid rock from Lake Rabun to Tallulah Lake. Here will be the Torrora plant.

The Seed dam and plant is also expected to reach completion in 1924. This will be rechristened the Nacooche plant, the company intending to restore the original Indian names to the rivers and mountains on its domain and to give Indian names to its various projects.

A new 110,000-volt line will be built from Lindale to the Tennessee state line, there to be interconnected with the lines of the Tennessee power companies under reciprocal agreement. Another line will be built from Marietta through Canton to Tate, Ga. This line will carry 38,000 volts and will supply power for many cotton mills and other manufacturing enterprises in that district.

The Atlanta district will come in for its share of the expenditure, more than $1,240,000 being available for use by the electric department of the company in that section.

Plans for 1924 of Puget Sound Power & Light

Approximately $5,000,000 will be expended in western Washington this year by the Puget Sound Power & Light Company of Seattle in carrying out an improvement and expansion program, according to an official announcement made by President A. W. Leonard on January 3. In addition, he announced, preliminary work will be done on the company's Baker River project, the ultimate development of which, it is conservatively estimated, will call for an investment of many millions of dollars.

The 1924 program as announced includes the immediate construction of an additional unit of the White River power plant at a cost of more than $1,000,000, the unit to produce 23,000 hp.; expenditure of $2,500,000 in building new transmission and distribution lines and making substation improvements, and many other expenditures.

The Baker River project is in Whatcom County, near Concrete, in the Cascade Mountains, near the Canadian boundary. The White River plant is the largest now owned and operated by the company. The unit now to be added will bring its capacity to 94,660 hp. This new unit will be in service by October or November next.

Baltimore Company Has 1924 Program of $8,000,000

It is officially announced that the Consolidated Gas, Electric Light & Power Company of Baltimore is engaged in the largest construction program in its history and that $8,000,000 will be necessary to cover extensions and improvements in 1924. At the present time the company is building an extension rated at 55,000 hp. to its Westport steam plant, which will be in operation early this year. Foundations are now being completed for two turbo-generators, which will bring the Consolidated's capacity to 275,000 hp.

Plans are being completed for a new steam station at Gould Street, Baltimore, to be rated at 60,000 hp. Work will be started in 1924 and the station will be ready in 1925, with two units as the initial equipment. In addition, a generating station on the company's property at Dundalk is projected.

Ontario Asks Ottawa to Back St. Lawrence Project

The Ontario provincial government at a Cabinet meeting this week formally authorized the Hydro-Electric Power Commission to apply to the Dominion government for permission to undertake the St. Lawrence development.

The Ontario government proposes that the Dominion government contribute approximately $7,500,000 and the province $30,000,000. The remaining $37,500,000 which would be necessary to complete the work would, by this plan, be paid by the United States.

Byllesby Record for 1923

Engineering and Construction Work in Nine States Is Summarized by General Manager

AN OUTLINE of the principal engineering and construction work accomplished by the Byllesby Engineering & Management Corporation in 1923 has been made by Francis C. Shenehon, vice-president and general manager of engineering and construction. This summary covers actual work and surveys in nine states where the Byllesby company operates—Minnesota, Wisconsin, North Dakota, South Dakota, Kentucky, Oklahoma, California, Oregon and Montana.

The most important construction project of the Northern States Power Company during the year was the 80,000-hp. High Bridge steam generating station at St. Paul, the foundations for which are completed and the superstructure being erected. This plant is designed for an ultimate capacity of 320,000 hp.

New steam turbines, of 2,600 hp. and 4,000 hp. respectively, were installed at Grand Forks and Fargo, N. D. Two 600-hp. boilers are ready at Sioux Falls, S. D., and a new 10,000-hp. turbine is well under way. Two 5,300-hp. hydro-electric units were installed at St. Croix Falls, Wis. Surveys have been in progress for water-power developments on the St. Croix River at Kettle River Rapids and St. Croix Falls; also on the Mississippi River for water-power developments at Monticello and Otsego, Minn. A 110,000-volt transmission line was designed and built connecting the Wissota power station with the stock yards substation at South St. Paul. This line is completed with the exception of river crossings. Rogers Lake substation, with a capacity of 20,000 hp., was completed; also a 110,000-volt steel-tower transmission line connecting the stock yards substation with the Rogers Lake substation and the Rogers Lake substation with High Bridge.

A 110,000-volt step-up substation at the Riverside steam plant in Minneapolis, with a capacity of 65,000 hp., and a corresponding step-down substation of similar capacity, known as the Aldrich substation, were designed and construction is well under way. A 110,000-volt transmission line connecting the Riverside station with the Aldrich substation was designed and completed.

KENTUCKY, OKLAHOMA AND COAST

An addition to the Louisville Gas & Electric Company's Waterside station was designed and built and a 27,000-hp. steam turbine installed, increasing the total generating capacity to 90,000 hp. Construction of this company's Western substation, a modern fireproof structure, equipped with truck-type switching equipment of the latest design, also was completed.

Two major pieces of engineering and construction were carried out at the properties of the Oklahoma Gas & Electric Company and its subsidiary, the Oklahoma General Power Company, the most important of which was the 30,000-hp. steam generating plant of the latter company at Muskogee, which is virtually complete. Foundations are finished and the building superstructure is under way for the 20,000-hp. steam generating plant at Harrah Lake.

The San Diego (Cal.) Consolidated Gas & Electric Company has in service a new 20,000-hp. turbine at station "B." This company also has completed substation "C" at San Diego, a modern fireproof structure with an installed capacity of 8,000 hp. in transformer and switching equipment.

The first 27,000-hp. hydro-electric unit of the El Dorado project in California has been completed, and the plant is scheduled for operation early this year.

Senator Oddie Favors a Department of Mines

Senator Oddie of Nevada, who is himself a mine operator, is contemplating the introduction into the United States Senate of a bill setting up a Department of Mines, the head of which would be a member of the President's Cabinet. This, he has become convinced, is the proper way for the federal government to approach a settlement of the problems of coal mining and distribution as these were brought out in the report of the Coal Commission. He thinks there should be in Washington a major governmental body to which the coal industry could look for encouragement, advice and the formulation of policies.

Coming Engineering Report on Coal Storage

The American Engineering Council's report on coal storage will be made public about February 1. At the meeting of the council in Washington last week Dean P. F. Walker of the University of Kansas submitted an outline of the report, of which sections will be devoted to the Great Lakes traffic and the storage facilities at the Lake Superior docks, to the conditions of supply and distribution in New England, to conditions in the various local communities, to the needs and practices of industries by groups, to special transportation conditions, including differences in the cost of transportation under summer and winter conditions, and to methods and costs of storage. Dean Walker said:

"It is gratifying to observe the progress made during 1923 in the bituminous industry. The usual summer sag in the production curve has not occurred. Stocks increased by 20,000,000 tons during the summer. New England and the Northwest are storing in larger amounts than ever before. The railroads in those same regions have followed suit. It would appear that the activities of the Coal Commission, the Fuel Administrator and of our committee have begun to bear fruit."

Competitor Asks Injunction Against Brewer Plans

A temporary injunction has been granted to the Terre Haute, Indianapolis & Eastern Traction Company by the Indiana Superior Court against the Merchants' Heat & Light Company, the Central Indiana Power Company and the Indiana Electric Corporation, three Joseph H. Brewer utility interests, to prevent these companies from constructing high-tension transmission lines across the rights-of-way of the traction company's interurban lines in Marion and Vigo Counties between Indianapolis and Martinsville and Terre Haute. The suit is directed in part at the transmission lines which the Indiana Electric Corporation is building between Indianapolis and its new superpower plant near Terre Haute. This line would cross the traction company's lines near Indianapolis.

The plea of the traction company sets forth that, in view of the permission which the Public Service Commission gave it some time ago to compete in the electric service field in Indianapolis, it plans to enlarge its plant and to line its rights-of-way with high-tension transmission lines.

Engineering Employment in 1924 Thought Promising

The outlook for engineering employment for 1924 is bright and all indications point to a better year than 1923, according to a bulletin issued by the American Association of Engineers from its Chicago office. Several large construction projects are going ahead and many new ones are in preparation. There is every indication that a big shortage of technical men will be experienced, especially during the first months of the year, the association thinks, and salaries of engineering positions may be advanced during this year by an average of 10 to 20 per cent.

There will be a demand for specialists in hydro-electric and power-house construction, the bulletin continues. The electrical field is booming, and an advancement in electrical engineering is anticipated, including opportunities in commercial lines. Greatest activity is looked for in the Middle West as far as Utah. In Utah the outlook is better than it has been for many years. Outside capital is carrying on investigations for the development of natural resources. The Far Northwest will be rather dull until after the middle of April. Building and utility construction in California continue active. The Southwest has been rather dull and may continue so for a few months. The work contemplated is not on a large scale. The South has been fairly active in engineering work and promises to continue so. The Northeast has been quiet, work slowing down and a number of men becoming unemployed. The outlook for spring is, however, good.

Merger Proposed of Southern Rhode Island Utilities

Through the formation of the South County Public Service Company, it is proposed to consolidate the Westerly Electric & Power Company, the Wickford Electric Light & Water Company and the Narragansett Pier Electric Light & Power Company, all of Rhode Island, giving improved service with immediate rate reductions of 1 cent per kilowatt-hour in lighting and power schedules. To a representative of the ELECTRICAL WORLD E. A. Barrows, president of the Narragansett Electric Lighting Company, Providence, with whose operations the above companies are affiliated, said that the capital involved in the proposed merger is about $850,000 and that more than ten thousand customers in the south county area will be benefited. No changes in personnel or capitalization are contemplated, but later it is expected that improvements in the distribution systems will be undertaken. William C. Clarke, Westerly, is manager of the three companies.

Briefer News

Annual Meeting of S. E. D.—The annual meeting of the Society for Electrical Development will be held at headquarters, 522 Fifth Avenue, New York, Tuesday, February 5, at 10 a.m. This will be followed by a two-day semi-annual meeting of the board of directors of the society.

Eidlitz Will Talk on "Taking Bunk Out of Building Contracts."—"Taking the Bunk Out of Building Contracts" is the subject of the address to be delivered by Charles L. Eidlitz, commissioner of the Electrical Contractors' Association of New York, Brooklyn, Queens, Bronx and Newark, before the New York Building Congress on January 23. The meeting will be held at the Commodore Hotel, New York City.

Kentucky Utilities Company Buys Three Plants.—The plants of the Paris Gas & Electric Company, the Carlisle Electric Light & Power Company and the Danville Light, Power & Traction Company have been acquired by the Kentucky Utilities Company, a Middle West Utilities Company subsidiary, from the Light & Development Company of St. Louis, as part of the Kentucky Utilities Company's expansion program.

Calumet Electric Company Seeks to Acquire Several Plants.—The Indiana Public Service Commission recently heard the petition of the Calumet Electric Company to buy for $260,000 the electric generating plants and distributing lines of the Interstate Public Service Company at Crown Point, Lowell, Cedar Lake and intervening points. No opposition to the proposal was made at the hearing. The Calumet company operates in Lake and Porter Counties.

Commonwealth Edison Receives Stock for Elevated Railway Bills.—The Commonwealth Edison Company has obtained common stock in the reorganized Chicago Elevated Railways in satisfaction of outstanding bills for electrical power. This action followed the purchase of the $20,329,500 common stock of the elevated railways' collateral trust by a committee which represented holders of notes for $14,000,000.

Electric Range Withstands Berkeley Fire.—This picture tells the story of an electric range which went through the disastrous fire last fall at Berkeley, Cal. The sturdiness and substantial construction of modern cooking units of this type are shown by the fact that all the burners were found in working order when the range was retrieved from the ruins of the building that housed it. Water was boiled on the range constantly when it was exhibited in its warped state at the San Francisco Industrial Exposition.

Maine Company Buys Power Rights on Carrabasset.—The Franklin Light & Power Company of Farmington, Me., has purchased the power rights on the Carrabasset River at North Anson, where it will build a dam and expects to develop 3,000 hp., which will enable it to dispense in full or part with its present purchase of power from the Central Maine Power Company.

Lake Superior Company May Buy Washburn and Medford (Wis.) Plants.—The Lake Superior District Power Company, which ownes and operates electric light and power, gas, local and interurban electric railway properties in northern Wisconsin and Michigan, has secured options to purchase the electric light and power plants of the Washburn Electric Light & Power Company and the Medford Light & Power Company. Under the terms of the option the properties will at once be operated by the Lake Superior company and within the next sixty days a decision will be made as to whether the plants will be purchased outright and made a part of the company's system. The two plants are valued at over $200,000.

Pennsylvania Power & Light Will Absorb Hughesville Plant.—The thirty-year-old Citizens' Light & Power Company of Hughesville, Pa., which supplies energy to Hughesville and Picture Rocks and has been operated by water power from the elevated lake at Eaglesmere, about 10 miles distant, is to be taken over by the Pennsylvania Power & Light Company.

Utah Power & Light Absorbs Evanston Company.—The Utah Power & Light Company has taken over the entire property of the Evanston Electric Light Company of Evanston, Wyo., and this property is now being operated as the Evanston division of the Utah company's system. H. L. Williams, former manager of the Evanston company, has been appointed division manager. The company's plans contemplate aggressive development of its new territory.

May Change Site of New River Dam.—To obviate danger of flooding the Norfolk & Western and Virginian Railway tracks and the Appalachian Power Company's plant at Glen Lyn, Va., the West Virginia Power Company will, it is understood, change the site of its dam across New River to a point about one and a half miles below the original site at the mouth of the Bluestone River in Summers County. The river has a fall of 6½ ft. between the proposed old site and the new one, and this will reduce the backwater from the dam below the danger point at Glen Lyn.

Highest Department-Store Signs.—New York City now boasts of the highest if not the largest department-store electric signs, the top of a new nineteen-story addition to the store of R. H. Macy & Company, having been crowned with a battery of four signs that can be seen from a distance of 15 miles. The signs carry the word "Macy's" and a red star, the symbol of the store, and one is placed on each side of the building. They measure 83 ft. by 33 ft. and the letters are 18 ft. high. To light the signs requires 5,000 lamps with a total rating of 329,000 watts.

Public Ownership Losing Popularity in St. John, N. B.—The transmission system built by the city of St. John, New Brunswick, to distribute hydro-electric power generated by the provincial government at Musquash has, according to a correspondent of the *Financial Post* of Toronto, not fulfilled expectations. Recently low-water conditions made it necessary for the city authorities to call on the private central-station company for assistance. This company, the New Brunswick

Power Company, now owned as well as managed by the Federal Light & Traction Company of New York, is in a favorable condition both financially and as regards public relations, and an advantageous offer of a Canadian firm to take it over is said to have been refused.

Belt Line in Kansas City, Kan., Electrified.—The outer belt line of the Kansas & Missouri Railway & Terminal Company in Kansas City, Kan., has been electrified. Electrically operated locomotives will haul passenger cars over part of the route, and freight trains will be hauled over its entire length. The line connects with five steam railroads, and it is anticipated that it will open up the territory through which it passes for industrial purposes, besides relieving freight congestion in Greater Kansas City.

Brooklyn Edison's 1923 Earnings Set Record.—An official estimate from the Brooklyn Edison Company indicates that in 1923 gross revenues amounted to more than $23,000,000, against $19,126,000 in 1922 and $16,396,000 in the previous year. The 1923 gross was almost three times the amount of business handled in 1918, when the total was $8,876,000. The company last year, it is estimated, took on 82,000 new customers, establishing a new high record for any year. With its expansion program at its peak the company is expecting to take on 100,000 new subscribers in 1924.

Two Transportation Bodies Effect a Merger.—At the regular monthly luncheon of the New York Electric Motor Truck Club, held January 3, it was unanimously agreed that the club should merge with the transportation committee of the Metropolitan Section of the National Electric Light Association. The action was the result of a feeling by members of both organizations that the original function of the club in creating good fellowship and friendly relations between manufacturers had been more than fulfilled and that, the time having come to broaden its scope, more would be gained by combining than by operating the two organizations along parallel lines.

Electrification in Napoleon's Native Island.—Corsica, although politically a part of France, has been backward in adopting electricity. A change, however, is coming, for the general council of the island has voted for the construction of transmission lines and the distribution of energy in rural communities as well as in the cities and villages. The fact that the island is only 100 miles in length and about 50 miles in width makes the plan practicable. In the north of the island it is proposed to obtain hydro-electric power from the Tavignano and Restonica Rivers, which in conjunction will furnish 6,000 hp. In the southern section electric buses or electric railways will be run, insuring a specified consumption of energy to begin with. An existing central station in that district will be supplemented by hydro-electric installations on the Prunelly, Taravo and Rizzanese Rivers. The water power available on the island and the absence of coal supplies are held to make the electrification proposal an attractive one.

Indiana Service Corporation's New Sources of Power.—Power from the large new hydro-electric plant of the Interstate Public Service Company on the Tippecanoe River near Monticello, Ind., was supplied recently for the first time to the Indiana Service Corporation and was used for the operation of the company's railway between Fort Wayne and Lafayette. A 20-mile transmission line from the Norway dam to Logansport, where it connects with the traction line, was recently completed. This line, in addition to supplying power to all interurban cars between Lafayette and Fort Wayne and to city street-car lines at Logansport, Peru and Wabash, will supply twelve or more communities along the transmission line.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations is published in the first issue of each volume. See January 5 issue, page 72, for latest list.]

National Association of Lighting Equipment Dealers—Hotel Sherman, Chicago, Jan. 21-26.

American Society of Safety Engineers—Engineering Societies Building, New York, Jan. 22.

Technical National Section, N. E. L. A.—Birmingham, Jan. 28-Feb. 1.

Western Association of Electrical Inspectors—Hotel Fontenelle, Omaha, Jan. 29-31. W. S. Boyd, 175 West Jackson Blvd., Chicago.

Iowa Engineering Society—Montrose Hotel, Cedar Rapids, Jan. 29-Feb. 1. R. H. Freese, Cedar Rapids.

American Institute of Electrical Engineers—Midwinter convention, Bellevue-Stratford Hotel, Philadelphia, Feb. 4-8. F. L. Hutchinson, 33 West 39th St., New York.

Society for Electrical Development—522 Fifth Ave., New York, Feb. 5. J. Smieton, Jr.

Commercial National Section, N. E. L. A.—Hotel Cleveland, Cleveland, Feb. 6-7.

American Physical Society—New York, Feb. 23.

Association of Electragists, Eastern Division—Hotel Astor, New York, March 18.

Illinois State Electric Association—Hotel Sherman, Springfield, Ill., March 26-27. R. V. Prather, Springfield, Ill.

American Institute of Electrical Engineers—Spring convention, Birmingham, Ala., April 7-11. W. E. Mitchell, Alabama Power Co., Birmingham.

Wisconsin Utilities Association—Hotel Pfister, Milwaukee, April 17-18. John N. Cadby, 445 Washington Bldg., Madison.

Southwestern Division, N. E. L. A.—New Orleans, April 22-25. S. J. Ballinger, San Antonio, Tex.

Southwestern Public Service Association—New Orleans, April 22-25. E. N. Willis, Dallas, Tex.

American Electrochemical Society—Hotel Bellevue-Stratford, Philadelphia, April 24-26. C. G. Fink, Columbia University, New York.

Nebraska Section, N. E. L. A.—Omaha, May 8-9. H. M. Davis, Bankers' Life Bldg., Lincoln.

National Electric Light Association—Atlantic City, N. J., May 19-23. M. H. Aylesworth, 29 West 39th St., New York.

Customers, Stockholders and Utility People Meet in Twin State Convention.—Five thousand invitations were sent to stockholders and customers of the Twin State Gas & Electric Company, Berlin district, to meet executives, department heads and employees of the property in New England at an "open house" scheduled for January 16 at the Gorham hydro-electric station of the Berlin division. This occasion was a part of a two-day convention of officers and women employees of the divisions in Berlin and Dover, N. H.; Brattleboro, St. Johnsbury and Bennington, Vt., and Hoosick Falls, N. Y., the object being to further public relations and to discuss intercompany problems. The program for January 17 included parallel sessions for managers and department heads and for women employees, with a dinner in the evening.

Progress of Pacific Coast Interconnection.—The important link in the interconnected transmission system of the West which will join the systems of the Washington Water Power Company and the Montana Power Company (see ELECTRICAL WORLD, Sept. 8, page 503) will be completed early in 1924. To close the gap between the main system of the Puget Sound Power & Light Company and its system in southwestern Washington, extending down to the Columbia River, a 10-mile high-tension line between Olympia and Tenino, Wash., is definitely projected. To bridge a third gap between The Dalles, and Umatilla, Ore., the Pacific Power & Light Company has surveyed the route for a proposed 60,000-volt line. When it shall have been built there will be an interconnected system linking Portland, Seattle, Spokane and Butte. Only one 18-mile gap will then exist in the network extending from Harlowtown, Mont., to the Mexican border, a distance of nearly two thousand miles.

Pennsylvania Power & Light Company's Expansion.—The high-tension line of the Pennsylvania Power & Light Company from Sunbury to Williamsport is being extended to Lock Haven. The completion of this work will give the company 649 miles of high-voltage and 1,870 miles of low-voltage distribution. A new 20,000-kw. unit in its Hauto plant and a 10,000-kw. unit at Williamsport have, with smaller installations, brought the total generator rating of the company to 156,555 kw., an increase of 44,205 kw. over last year, when the properties of the Excelsior Electric Light & Power Company of Sellersville, the Lycoming Edison Company, the Lock Haven Electric Light & Power Company, the Jersey Shore Electric Company and the Wilkes-Barre Company (previously operated under lease) were taken over. The projected 40,000-kw. initial hydro-electric plant at Hawley, on the Wallenpaupack Creek, with 60-mile transmission at 220,000 volts over a new steel-tower line, is the main item now on the company's program.

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men Engaged in all Branches of the Electrical Industry

E. A. Robert Resigns Presidency of Tramways & Power Company

E. A. Robert, president of the Montreal Tramways & Power Company since its organization about fourteen years ago, recently resigned. Mr. Robert has long been a conspicuous figure in the electrical industry in Canada and at the present time is an officer in several of its representative light and power companies. His successor as president of the Montreal Tramways & Power Company is William C. Finley, formerly vice-president of the company. Mr. Robert will remain as head of the Montreal Tramways, controlled by the Tramways & Power Company.

F. W. Peek, Jr., consulting engineer to the General Electric Company, was awarded the Thomas Fitch Rowland prize on January 16 for a paper he prepared entitled "High-Voltage Power Transmission." The prize, instituted by the American Society of Civil Engineers in 1882 and endowed two years later by the late Thomas Fitch Rowland, honorary member of the society at that time, consists of $60 in cash and an engraved certificate signed by the president and secretary. Mr. Peek is considered an authority on high-voltage engineering and transmission-line practice.

Curtis S. Mitchell has been appointed vice-president and controller of the Philadelphia Company, with headquarters in Pittsburgh, Pa. In addition to handling the responsibilities of controller Mr. Mitchell will perform other duties which may be assigned by the president.

Max A. Pooler, general manager of the New Brunswick Power Company, has been elected to a vice-presidency on the board of directors of the company. Mr. Pooler became associated with the New Brunswick company in 1922, going there from Frederick, Md., where he had been manager of the Potomac Public Service Company.

Hartwell Jalonick has resigned as commercial manager of the Texas Power & Light Company, Dallas, in charge of all its commercial activities, including merchandise sales. Mr. Jalonick is opening offices in Dallas as manufacturers' agent, selling to central stations and jobbers in the states of Texas, Oklahoma, Arkansas and Louisiana.

Howard Ansley, who has been associated with the Nashville (Tenn.) Railway & Light Company since 1913, when he entered its lighting and sales department, has been appointed manager of the securities department of the Tennessee Electric Power Company, Chattanooga, Tenn. The Tennessee Electric Power Company controls the Nashville company.

R. A. Chattock, Engineer of Birmingham, England

Richard Alexander Chattock, city electrical engineer to the Birmingham (England) Corporation since 1903, has been identified with the electric supply industry for the past thirty-four years. Mr. Chattock is a native of Birmingham and received his technical training at the University College, London. In 1889 he became assistant engineer to the Metropolitan Electric Supply Company and subsequently was made superintendent engineer at one of the company's stations. After serving as chief electrical engineer to the vestry of St. John, London, for a short time, he joined the City of London Electric Lighting Company at the Bankside station in the capacity of superintendent engineer, where he remained for five years. In 1900 he was appointed chief electrical engineer to the Bradford Corporation, but resigned his post in 1903 to become city electrical engineer at Birmingham. During the period Mr. Chattock has been at Birmingham he has had charge of the development of the electric supply undertaking of the corporation, comprising the design and erection of a large power station and a number of substations in the outlying districts of the city.

R. A. CHATTOCK

Mr. Chattock has taken an active part in the representative electrical engineering associations, having served as vice-president of the Institution of Electrical Engineers, president of the Incorporated Municipal Electrical Association and president of the Birmingham Association of Mechanical Engineers.

Jay A. Sly, distribution engineer in the engineering department of the Idaho Power Company, has resigned to become district superintendent of distribution of the Northwestern Electric Company of Portland in its Vancouver district. Mr. Sly has been associated with the Idaho Power Company for the past three years.

F. E. Schornstein, district manager of the Wisconsin-Minnesota Light & Power Company at Eau Claire, Wis., has recently resigned. As district manager of the company Mr. Schornstein had supervision over the electric light and power supply in Eau Claire, Chippewa Falls and numerous other cities in that section of the state as well as of the electric railway department in Eau Claire and the interurban line between Chippewa Falls, Eau Claire and Altoona. Before going to Eau Claire in 1920 he was in charge of the company's electric light and power department at Red Wing, Minn., for three years. It is understood that Mr. Schornstein will soon leave Eau Claire for the East.

George T. Bishop, chairman of the board of the Niagara, Lockport & Ontario Power Company, Lockport, N. Y., has been elected to a similar position with the United Gas & Electric Corporation, New York City.

Harold F. Marshall, until recently advertising manager for Dwight P. Robinson & Company, Inc., engineers and constructors, left New York early in January to take up his new duties as advertising manager for Warren Webster & Company, engineers and manufacturers of steam-heating systems, Camden, N. J.

W. K. Beard, advertising representative of the ELECTRICAL WORLD and *Electric Railway Journal* in the Philadelphia territory, and **C. A. Babtiste**, advertising representative of the *Electric Railway Journal* in the New York territory, were the guests of honor at a recent dinner at the University Club, New York City. The dinner, given by the McGraw-Hill Company, publisher of the papers named, was to celebrate the completion of more than a quarter of a century of service by Mr. Beard and Mr. Babtiste and was attended by one hundred and fifty of the company's representative men. James H. McGraw as toastmaster paid tribute to the guests of the evening, presenting each with a check for $1,000, inclosed in a letter of appreciation of their dependable and loyal services. In responding, Mr. Beard expressed his gratitude for the sympathetic consideration accorded him by the company during his twenty-eight years of service on the staff of the ELECTRICAL WORLD and for the opportunity he had thus had to have a part in the

service rendered by it to the industry. Mr. Babtiste also made an address in which he depicted the attractions and opportunities of the publishing business.

Henry C. Stair, secretary of the Cambridge-Albion Light & Power Company, has retired from the public utility field to enter the newspaper business. His financial interests in the concern were purchased by John W. Porter, president of the company, who assumes entire control.

William B. Anthony, division manager of the Oklahoma Gas & Electric Company at Shawnee, has been appointed to a supervising position in the general offices of the organization in Oklahoma City.

W. S. Whistler, office manager of the Oklahoma Gas & Electric Company in Oklahoma City, has been made division manager of the company at Shawnee, succeeding William B. Anthony, recently appointed to a supervising position in Oklahoma City.

Clifford Bartlett, district manager of the Pacific Gas & Electric Company at Willows, Cal., has been made assistant manager of the North Bay division of that company with headquarters at San Rafael, Cal. Mr. Bartlett became associated with the Northern California Power Company, now a part of the Pacific Gas & Electric at Redding, Cal., in 1906. He was made district manager at Willows in 1910, which position he retained until his recent appointment.

G. M. U. Tait, who has been associated with the engineering department of Stone & Webster, Inc., engaging in appraisal work, has been transferred to the construction department.

Don Overton, chief operating engineer at the power house of the Nebraska Power Company, Omaha, has left the station to become superintendent of power stations with the Minnesota Power & Light Company, Duluth. Charles Turner has succeeded Mr. Overton.

H. G. Acres of the Ontario Hydro-Electric Power Commission has been appointed consulting electrical engineer by the New Brunswick government in connection with the development of hydro-electricity at Grand Falls, N. B. Mr. Acres will soon visit Grand Falls to make a report, upon which will be based the proposed development.

W. C. Stevens, general sales manager of the Cutler-Hammer Manufacturing Company of Milwaukee and New York since 1917, has been made director of developments for all departments of the company. Mr. Stevens, who is a graduate of Cornell University, entered the employ of the Cutler-Hammer Company in the student engineering course in 1906, and has since then been successively in the engineering department, head of the steel-mill sales engineering work and district manager of the Chicago, Boston and New York offices. He is also a member of the board of directors.

G. O. Nicolai Succeeds Walker in Terre Haute

G. O. Nicolai has been appointed general manager of the Terre Haute division of the Terre Haute, Indianapolis & Eastern Traction Company, succeeding E. M. Walker, who recently resigned to become president of the Schenectady Railway. Mr. Nicolai has been connected with the company in Terre Haute since 1903, when he entered the purchasing department as a clerk. Subsequently he was transferred to the light and power department, of which he became chief clerk before being advanced to the position of commercial agent. Later he was made superintendent of the light and power department, which position he occupied until his appointment as general manager.

Eustace C. Soares, for the past three and a half years associated with Ophuls & Hill, Inc., consulting engineers of New York, has been appointed assistant editor of the staff of the ELECTRICAL WORLD in the manufacturing and markets department. Mr. Soares is a technical man and brings to his new position a broad knowledge obtained from a varied experience with central-station and manufacturing companies. As electrical engineer with Ophuls & Hill his duties included the drawing up of plans and specifications, extensive buying and recommendations for buying on the basis of quality and price, besides some installation work. He has been at different times connected with the Westchester Lighting Company, the Brooklyn Edison Company and the United Electric Light & Power Company, and previous to his association with Ophuls & Hill he was identified for four years with the Crocker-Wheeler Company in its testing, maintenance and repair departments. Mr. Soares has been a frequent contributor to the industrial practice section of the ELECTRICAL WORLD and also to the *Industrial Engineer*.

F. L. Wise, local manager of the North Western Ohio Light Company at Van Wert, Ohio, has resigned his position to go into the electrical contracting business in California.

Roy Porter, electrical engineer with the Alabama Power Company, has been transferred from the office of superintendent of distribution at Birmingham to the engineering department at Montgomery.

George W. Boteler, manager of the electric and gas departments of the Wisconsin Gas & Electric Company at Waukesha, has been made district manager of the Watertown, Burlington and Whitewater divisions of the company. He will be placed in charge of the operation of the appliance sales departments of all of the company's offices in Waukesha and in cities and towns in Dodge and Jefferson Counties and parts of Walworth County. Mr. Boteler, who was associated with the Waukesha Gas & Electric Company before it was acquired by the Wisconsin company, will remain as manager of the Waukesha office, which will continue to serve as his headquarters, and from this point he will carry on the work he has just undertaken.

C. F. Robertson, for the past year power station operator of the Cape Breton Electric Company, Ltd., Sydney, N. S., has resigned and is now connected with the United Illuminating Company of Bridgeport, Conn.

G. S. Crane has been appointed general sales manager of the Cutler-Hammer Manufacturing Company to succeed W. C. Stevens, recently made director of developments for all departments of the company. Mr. Crane has been associated with the Cutler-Hammer Company since 1910, when he entered the student engineering course. Since that time he has been connected with the engineering department, in the Pittsburgh office and in the Cleveland office as manager. For the past three years he has been manager of controller sales at the main offices in Milwaukee.

Adolph G. Denbin, formerly general tester with the New York Edison Company, is now connected with the United Railways & Electric Company of Baltimore as electrical engineer.

Charles Pepper, manager in charge of the sales department of the Wisconsin Public Service Corporation and its predecessors for several years, has been made assistant manager of the corporation. Mr. Pepper will continue to be in charge of the company's sales force at Sheboygan.

Obituary

William Hoopes, head of the research and technical departments of the Aluminum Company of America, died January 9 at his home in Pittsburgh. Mr. Hoopes, who was fifty-seven years of age, was nationally known as an aluminum expert. Since 1900 he had been chief electrical engineer of the Aluminum Company in charge of all the electrical developments of the organization. He was formerly engaged in the construction and operation of electric lighting plants and at one time was on the staff of the Westinghouse Electric & Manufacturing Company in Pittsburgh.

W. Raymond Hosmann, an assistant production manager of the General Electric Company's Lynn (Mass.) works, died January 11 at his home in Salem, Mass. He had been in the employ of the company about ten years.

George Clapperton, vice-president, traffic manager and a director of the Commercial Cable Company, New York, died on January 11 at St. Luke's Hospital. Mr. Clapperton, a native of England, came to America in 1874 and ten years later entered the employ of the Commercial Cable Company. He was seventy years of age.

Commission Rulings

Competitive Bidding for Street-Lighting System.—Award of a contract to install and maintain a system of underground street lighting in Williamsport, Pa., to the Lycoming Edison Company was opposed before the Public Service Commission of Pennsylvania on the ground that the requisite cable could be obtained only from the General Electric Company and that the date of delivery quoted by that company to a would-be bidder, the Citizens' Electric Company of Williamsport, made it impossible for the latter to enter into a contract to complete the work in the desired time and insured the contract going to the Lycoming company, which has affiliations with the General Electric. The commission did not find these allegations sustained. Further objection was made that the contract was against the interest of the city because the system would remain the property of the Lycoming Edison Company and could be removed by it at the expiration of ten years. On this point the commission said: "The city is not contributing anything toward the installation of this lighting plant or its operation. The extent of the city's obligation or liability in connection therewith is the payment of so much per lamp used, which payment is the usual and ordinary charge made for like service. If at the expiration of the ten-year period fixed in the contract the city is not satisfied with the system or is unable to make satisfactory arrangement for a continuance of the service furnished thereby, it is at liberty to install its own system or to contract for some other method for lighting its streets."

Attorney-General Improper Complainant.—Basing its holding upon the elementary principle that parties who are not injured cannot be heard to complain and upon the absence of any statutory authority, the Montana Public Service Commission held that the Attorney-General of the State was an improper plaintiff in a proceeding, Montana ex rel. Rankin vs. Helena Light & Railway Company, wherein rates established by the commission were attacked. The commission, as quoted in *Public Utility Reports*, reviewed constitutional and statutory provisions imposing upon the Attorney-General the legal duty of enforcing rules, orders, rates, classifications and regulations made by the commission and of defending them when attacked in court and declared that by clear implication the statute prohibited that officer from initiating an attack upon such rules, orders, rates, classifications or regulations, stating that the obligation to enforce compliance and defend is so inconsistent with the existence of the power or authority to attack that the two cannot exist together. The commission maintained that it was itself the representative of the state in rate making and that the complaint in this case presented the anomalous situation of the state complaining with respect to the rates which it had itself established, continuing: "The absurdity of such a position requires no comment, and the only question to be considered is whether the Legislature intended to authorize or permit any such anomalous situation to arise. Presumably it would not. Having established a commission of public officials and charged them with the duty of prescribing just and reasonable rates, tolls, regulations and charges to be observed by public utilities, it is to be presumed that the state, in its governmental capacity at least, was to be content with the rates, tolls and charges which the commission should, in the absence of fraud, fix. At any rate the statute specifically charges the commission, and not the Attorney-General, with the duty of enforcing 'the provisions of this act.'" The right of the state to complain in its proprietary capacity as a user of electricity was also discussed, and the commission held that in this instance, as in all others, the state must appear by its representative, the Public Service Commission.

Limited Primary Supply and Off-Peak Service.—Application was made by the General Necessities Corporation to the Michigan Public Utilities Commission to require the Detroit Edison Company to continue a certain type of electric service known as "limited primary power supply." In denying the application the commission said that an attempt to protect an occasional peak of 10 or 15 per cent, and of an uncertain location, does not justify the expense of such protection by continuing a limited primary supply electric rate when the demand is not unified or controlled from a single point, although these rates may have been proper when industrial conditions resulted in a definite peak during certain hours. A consumer who can increase his demand during the off-peak hours should get a rate at least as low as, if not lower than, the customer carrying a uniform rate for twenty-four hours, although the twenty-four-hour consumer with a uniform consumption is inherently entitled to the greatest consideration. The question whether a power consumer should receive preferential treatment on account of being in some degree a seasonal consumer cannot, the commission said, be discussed separately from the question of demand charges for all other types of service, since a different determination of demand might effect certain changes in the distribution of demand revenue between the different classes of consumers but would probably not radically change such demand as a whole. The commission further declared that a regulating body should not substitute its judgment for the judgment of the owners in the business affairs of the utility, such as the construction of electric rate schedules, upon the theory that the utility no longer has an off-peak service except during a certain period.

Recent Court Decisions

Farmers' Association Supplying Electricity to Members Is Not a Utility.—The orders of the Wisconsin Railroad Commission to the Lincoln Highway Light Company, an association of farmers formed to supply themselves with electricity, that it should serve at a prescribed rate three former rural customers of the Manitowoc municipal plant who, at the commission's instance, had been connected to the Lincoln Highway Light Company's lines (see ELECTRICAL WORLD, Sept. 23, 1922, page 683, and May 5, 1923, page 1058), have been overruled by the Circuit Court, which holds that the company is not a public utility and that the commission had no power to enter any order directing it to supply electric service to any person not a member of the association. The three petitioners will have either to become members of the association on equal terms with the other members or submit to such rates and charges as the Lincoln Highway Light Company may make. The decision does not affect the city of Manitowoc, from which the association buys its energy.

That Contributory Negligence Was Not Established in Suit for Damages for Death Does Not Settle Issue in Suit by Another for Damages to Property.—The executrices of one John S. Weeks recovered from the Adirondack Power & Light Corporation damages because of his death from a gas explosion due to a leak in the company's pipes, the accusation of contributory negligence raised by the defendant not being sustained by the trial court. Damages to the decedent's property caused by the same explosion were paid by the United States Fire Insurance Company, which sued the Adirondack Power & Light Corporation to recover the amount thus paid and interest thereon. In the trial of this suit the insurance company claimed that the issue of contributory negligence was now *res judicata* (or a thing already judged) and the lower court sustained this claim. The Supreme Court, Appellate Division, has reversed this judgment and ordered a new trial, asserting that before such an issue can be *res judicata* the parties to the action must have appeared in the same capacity in both suits. (201 N. Y. S. 643.)*

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

A Practical Economy in Distribution

Influence of Jobbers' Catalogs on Simplification—Benefits from Catalogs That Discourage Unstocked Listings—Other Advantages of the Plan

A VERY practical economy in the cost of the distribution of electrical supply lines has been put into effect with the publication of the first jobbers' catalog under the new plan of the Electrical Supply Jobbers' Association. A catalog committee composed of W. I. Bickford of Pittsburgh (chairman), Frank Bernardin of Kansas City, W. E. Robertson of Buffalo, F. W. Van Winkle of Cincinnati and George Patterson of New York is directing this new activity and producing catalogs for member jobbers on a basis that is intended to effect a very considerable economy in the cost of the catalogs themselves, but particularly to influence a reduction in the number of varieties listed in jobbers' catalogs and to reduce the duplication of lines. The first book was recently published for the Elliott-Lewis Electrical Company of Philadelphia.

Influence on Simplification

In the past the publication of jobbers' catalogs has been in the hands of private publishing companies, which have undertaken to compile the products of the different electrical manufacturers and make them available to electrical jobbers. It has been common practice to charge the manufacturers $10 per page for cataloging their lines and then to carry these pages in stock, making changes as necessary and combining into a catalog such pages as the jobber might desire. The price of any jobbers' catalog, however, would naturally depend upon the number of pages it contained, and it has been the natural desire of the publisher to list the maximum number of varieties in all lines to make the catalog as large as possible and increase the profit on the job. This, it is claimed, has had no small influence in increasing the number of excess, duplicate and obsolete varieties of electrical material which have commonly been listed by electrical jobbers.

A few years ago, when electrical jobbers became alarmed at the steady increase in the size of their lines and began to work for the simplification of supply lines, a number of the prominent members of the jobbers' association organized a publishing house of their own, known as the Jobbers' Catalog Company, at Grand Rapids, Mich., to undertake the publishing of jobbers' catalogs for members of the association who might desire to put the work in the hands of men recognizing the importance of condensing catalogs of electrical supplies. The company was successful to a degree which demonstrated to the association the importance of a more sympathetic and understanding direction of the compilation of electrical jobbers' catalogs. The amount of money that was saved for jobbers and the amount of condensation which was achieved made it evident that much could be gained for the industry if the publication of jobbers' catalogs could be taken up on a large scale on a co-operative basis. The eighteen stockholders of the old Jobbers' Catalog Company, therefore, recently turned the enterprise over to the jobbers' association, and the association under the direction of its catalog committee has undertaken a reorganization of the work and established it with adequate financial backing.

Burden of Unstocked Listings

The influence of the electrical supply jobbers' catalog today is very far reaching. It is used as a data book and an encyclopedia of material. Wiring contractors use it in planning and figuring installations. Engineers and architects use it in making specifications for jobs. In central stations and industrial plants it is used as a handy reference book in ordering. The materials listed in this book therefore determine to a very considerable extent what varieties of material are purchased in the ordinary course of business, and the fact that jobbers' catalogs in the past have habitually listed a far broader line than any jobber pretends to carry in stock has resulted in much waste of time and money and costs dearly in poor service. In fact, it has worked a very severe injustice on the buyer, who naturally accepts all material listed in the jobbers' catalog as offered for sale, with the assumption that all these varieties are carried in stock. Oftentimes a choice may easily be made between the two devices seen in the book, one of which is carried in the jobbers' stock and the other not. The purchaser could specify the one available in stock if he knew that the other would entail waiting, but in the absence of this information he selects the wrong one and suffers the consequences.

Entire Industry Suffers

The jobber thus receives an order for something he does not carry on hand and is forced in turn to make a special purchase from the manufacturer. Meanwhile time passes and the jobber's reputation suffers because of poor service. Moreover, a further and very practical hardship is entailed of which the purchaser is entirely ignorant. Because of this listing of material that is not carried in stock the jobber is compelled to make many small purchases of the manufacturer on which he receives a much smaller discount and profit than he would on a standard device which he buys in quantities and carries in stock. Likewise the manufacturer is penalized because it costs him more to sell these small orders than to sell in larger quantities. Clearly, therefore, the entire industry suffers by the listing of material in jobbers' catalogs that is not carried in stock by the jobbers.

The elimination of excess varieties from the jobbers' catalogs naturally requires the most experi-

enced discrimination. The fact that the Elliott-Lewis catalog has been reduced from 900 pages to 556, the condulet line, for instance, being cut from 216 pages to 52 pages, shows how much can be accomplished. This reduction in size, however, was accomplished only in part through the elimination of excess varieties. Much was done through the better arrangement of the pages, and a very great improvement has been wrought in the method of illustrating and the display of illustrations and tabulations upon the pages. Several thousand dollars was saved for this jobber.

Three Advantages Offered

In addition to all this three other distinct advantages to the jobbers of the association are expected to result from this co-operative publishing of jobbers' catalogs.

1. A loose-leaf catalog service is to be maintained for the members of the organization of any jobber using an association catalog. This will be revised up to date just as quickly as changes are made in the line of any manufacturer listed in that catalog. It is inevitable that before any bound catalog can be published some price changes will take effect and that therefore some pages in the book will be inaccurate when it is issued. Under the new plan, as changes are made in manufacturers' lines, revision will be made on the master pages retained by the association, and new sheets will be sent out so that members' own books may be kept constantly up to date.

2. The association will maintain for jobber members who use an association catalog a complete encyclopedia of electrical lines, kept up to date by the use of loose leaves. Every jobber in his own catalog, of course, lists only the lines he himself sells, but it is very desirable and necessary for him to have available also complete data on competitive lines of materials similar to those he sells. It will require a loose-leaf catalog of approximately four thousand pages, it is estimated, to list practically everything which is sold by wholesalers of electrical supply lines, and this is to be made available to any member of the jobbers' association who may care to purchase it.

3. There will also be made available to jobber members who do not publish bound catalogs loose-leaf catalogs of the lines they sell, which will be compiled from the standard sheets in the possession of the jobbers' catalog committee and can be made up in whatever number is necessary to provide copies for all the members of that jobbers' organization whom he may desire to be provided with them. This will be a very valuable service to houses which do not publish catalogs and in the past have had to compile their own makeshift data books from various sources.

It may be considered by many that a jobbers' catalog is a matter that principally concerns the jobber himself, but as a matter of fact this is not so. Taken in the mass, the supply catalogs wield a tremendous influence in the buying habits of the industry, and any such improvement as this, effecting both the elimination of excess varieties and the reduction of the size of catalogs, is distinctly in the interest of the industry. It is said that at the present time about $90,000 worth of catalogs are in process under the new plan, and the opportunity for money saving per year must be considerable. The real value, however, will come in the reaction from these catalogs, through a reduction in the number of small orders to the jobber and then from the jobber to the manufacturer, and the elimination of the costly delays which this entails, affecting the engineer, architect, contractor, industrial plants and, most of all, the general public. The plan represents a practical economy in distribution that should be recognized as a very valuable service to the industry and should have the support of all jobbers.

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

INTEREST is shown all over the country this week in the fact that business is recovering much more rapidly than usual from the influences of inventory taking. Apparently stocks were held down more successfully and in better balance this year than has been the past experience, for buying is general and in very healthy volume with prices firm. The continuance of open weather is encouraging general building construction and outdoor work among the utilities, which has a good influence on the market. Conditions in the textile industry appear to be somewhat improved, and there is a natural reaction from this, particularly in New England. Collections throughout the country show steady improvement. Final reports from many prominent electrical manufacturers, showing large figures for the year 1923, have thrown an added note of optimism into the general business situation.

Chicago reports the insulator manufacturers sold out to capacity many months in advance, though producers in the small-porcelain line, knobs, tubes and cleats, are quiet and have been reducing prices. An effort is apparently being made in the New York district to square up the price situation in the armored-cable field through a price reduction by a number of houses. In the same locality an improvement is reported in the used-machinery field. Reports from the South indicate an awakening interest in electric washing machines, which seems to be an outcome of the continued migration of negro labor from the Southern States and may have a considerable influence on the general market for electrical labor-saving equipment. The continued active campaign of kitchen lighting units is serving to increase general interest in the subject of better home lighting, and the general fixture business seems to be deriving considerable benefit. The Pacific Coast reports an active market with firm prices, but with a spirit of caution in evidence among the buyers.

Trend to Wall Brackets—Silk and Crystal in Favor

MANUFACTURERS of residential, office and hotel fixtures of best quality agree that present sales are somewhat higher than in the post-holiday period last year and that the immediate future holds many satisfactory orders in store, especially in the office and hotel field, because of the many such buildings now nearing completion. They point out also the fact that the first-line hostelries will soon come into the market for many dollars' worth of replacements and for spring and summer changes in decorations.

As the holiday buying brings the largest business in any season to these supply houses, authorities in this field are in a position to report many developments in the course of the market as regards style and kinds of materials used. A feature of the market is the trend to crystal for hotels and residences. Styles in this material, of course, are not so elaborate as in the Colonial, but run more to solid, heavy pieces.

A certain psychology affecting the average buyer has entered into the fixture market to place the annual sales in crystal far above what they were

just preceding the war, according to a leading authority in the New York field. He points out that in the fixture business the consumer generally desires the thing that is not generally shown in stock, and as this crystal is mostly imported from Bohemia there were increasing sales all through last year to people who had waited long for their orders to be filled. Prices during the last fifteen months for this kind of material have trended upward.

Silk shades for both hotels and residences are becoming more popular, and in the present market silk is cheaper than parchment and more adaptable.

The demand is moving away from ceiling lights and more wall brackets are being sold. Ceiling lights are little used, except for dining-room purposes, because of the accepted use of portables and reading lamps in the domestic life of the better homes of the country. Silver-mounted and wrought-iron bases are being used extensively by the fixture manufacturers, while a great quantity of wooden bases and materials for gilt trim like plaster and clay is being unloaded on the market for supplying those of less particular tastes.

Armored Cable Makers Move to End "Price Slashing"

WHAT is thought to be an important change for the better in the highly competitive status of the armored-cable market of the Eastern territory occurred when a group of three manufacturers of "quality" material each in his turn decided to put an end to the price slashing of the smaller makers by announcing on January 16 radical reductions on No. 14 solid. These reductions ranged from $1.50 to $2. The result of this drastic action, taken to stop the demoralization of a normal market subject to unusual demand from the building industry and industrial firms, has been reflected in two directions. Already there is a noticeable improvement in the prices quoted by the jobbers in the whole metropolitan territory, and there is a general tendency to stay near one price. Moreover, during the week two of the smaller makers who are known to have done the most price cutting during the last year stopped production for the time being. It is heard in different quarters of the trade that these interests have asked for mercy, but to no avail as the larger companies are out to bring improved conditions for every seller in the armored-cable market.

An interesting feature of the situation is the fact that these manufacturers in making their specific reductions changed the Pittsburgh base price to New York. In commenting on competitive conditions in the armored-cable market in last week's issue it was stated that the price to the jobber at New York amounted to $41.98 per 1,000 ft. in medium quantities with contract. The price is now at $40, New York, which was approximately the Pittsburgh base price. In connection with the reduction by the makers, jobbers' prices in general have fallen from $46 to $44 throughout the market in the metropolitan territory.

The present price levels are not expected to last more than two weeks, according to one important interest, because of the very small margins of profit both to the manufacturer and jobber. To show the great cost of manufacture at the accepted price of $40, one maker showed by his books that steel alone in 1,000 ft. amounts to a little over $19 and the wire to $16.50. He added no charge for labor and overhead.

Delinquent Electrical Accounts Decrease in December

IN ALL of the five districts reporting to the National Electrical Credit Association the number of delinquent electrical accounts for December, 1923, was lower than during November. In comparing these reports with December, 1922, two of the divisions had a lower number of delinquent accounts while the remaining three had minor increases. Although the December, 1923, accounts in the Chicago (central division) territory now total $92,731.23, the average amount still remains about the same as for December, 1922. In the Philadelphia territory the average amount increased compared with December, 1922. In both the New York and Pacific Coast territory the total amount and average amount decreased. Complete data are given in the accompanying table.

DELINQUENT ACCOUNTS IN DECEMBER

Branch and Month	Number of Delinquent Accounts Reported	Total Amount	Average Amount
Central Division:			
Nov., 1922	813	$141,482.10	$174.02
Nov., 1923	912	146,308.04	160.43
Dec., 1922	1,104	126,342,89	125.84
Dec., 1923	746	92,731.23	124.30
New York:			
Nov., 1922	389	84,743.00	218.00
Nov., 1923	344	50,725.00	145.00
Dec., 1922	485	93,428.00	193.00
Dec., 1923	344	42,943.00	125.00
Philadelphia:			
Nov., 1922	215	24,703.46	114.90
Nov., 1923	222	29,708.60	133.82
Dec., 1922	183	19,307.58	105.51
Dec., 1923	208	28,025.04	134.74
New England:			
Nov., 1922	47	6,130.29	130.43
Nov., 1923	51	6,018.34	118.01
Dec., 1922	34	3,809.69	112.05
Dec., 1923	36	4,176.85	116.02
Pacific Coast:			
Nov., 1922	24	4,117.10	171.54
Nov., 1923	18	4,252.62	236.25
Dec., 1922	14	2,225.43	158.90
Dec., 1923	17	1,791.96	105.40

Southeast Shows Early Improvement After Inventory Period

GENERAL appearances indicate that recovery after the inventory period will be more rapid this year than heretofore, business already showing some signs of awakening. There has been no let-up in the radio line, and as jobbers had stocks ordered for delivery immediately after Christmas, there has been no difficulty in meeting the demand.

Lighting fixtures of the residential and commercial types are moving well, with the better-class fixtures more in demand, and this line will be further stimulated in the near future by sales campaigns on kitchen lighting units about to be put on by central-station companies in this section. Telephone equipment is in heavy demand with stocks very low and orders accepted only for long-term delivery.

It is encouraging to note that several local dealers report an awakened interest on the part of the public in washing machines—a line which has been practically dead for many months in the South. As a result one of the largest dealers is planning a sales campaign on this specialty to begin within the next thirty days.

Business Good on the Coast—Some Motor Price Revisions

BUILDING construction on the Pacific Coast is very active and continues to provide a strong market for electrical materials. In San Francisco what may be called the center of electrical construction has moved from downtown business and industrial building to the outlying residence districts, where an entire block under construction is a common sight. Electrical wiring staples, such as conduit, rubber-covered wire, boxes and the like, are showing a good volume, but in comparatively small-sized orders, indicating a rather cautious market in spite of the fact that prices are generally steady and collections are not only good but continue to show improvement.

Annual inventories and year-end accounting have been interfering with the usual smooth movement of business, resulting in a subnormal though seasonal condition. However, several large assorted rubber-covered-wire orders are reported as well as some good sales of rigid-iron conduit to railroads. Schedule material such as sockets and switches is moving well. The emphasis put upon new devices as candle sockets and similar products and the creation of new fields of sale like that opened by the convenience outlet have entirely changed the general conditions of schedule selling. Collections are steadily improving, and their present average, just short of fifty days, is nearly ten days better than in January, 1923.

Certain motor prices have been slightly revised because of frame changes, but in general motors are pretty steady. Stocks are rather high. The next few weeks will decide whether or not the pumping-motor season is to be successful. The light rainfall will intensify the demand, but unless the rainfall soon increases it may come too late for the farmers to be able to afford such an investment. For the same reason farm-plant sales have practically ceased.

Radio Tube Prices Lower—High-Tension Insulator Production Slow in Middle West

THE most important announcement this week in Chicago electric circles was the price reduction of radio tubes. The WD-11, WD-12, UV-199 and UV-201A tubes were each reduced to $5 list price, effective January 11. Radio buying is continuing very brisk, parts are in great demand and stocks are low.

The delivery outlook on high-tension insulators is not promising. All insulator factories are sold on most lines to their entire capacity many months in advance. The supply of 6,000-volt insulators will in all probability be adequate, but in higher voltages the anticipated demand approximates closely the yearly capacity of existing factories. In a desire to keep their plants operating at capacity several manufacturers of smaller insulator equipment have reduced the price of knobs, tubes and cleats to practically cost. This condition is not expected to continue for a great length of time, since the spring building construction for 1924 is expected to be good and require a large volume of insulators.

Other electrical commodities are enjoying a fair sale with only a few outstanding features. Jobbers are taking this opportunity of looking over their stocks and making their plans for future business.

Demand Good, Prices Firm in the New York District—Used Machinery Stronger

NEW YORK'S electrical market has settled down to an exceptionally good demand, with prices comparatively firm. During the week there were only two price changes recorded by the jobbers. Armored cable experienced a two-dollar drop to $44 in the leading houses, due to drastic measures taken by a group of manufacturers in an effort to show those who have been paring down prices during the entire year that they intend to improve conditions in that market. The other price change is for friction tape, which advanced from 32 cents to 35 cents on Saturday last. This increase was made because of the recent upward movement of the linen and rubber markets.

Some improvement is reported in the wire and conduit markets, where a large volume is being used in office and industrial buildings which are nearing completion. One manufacturer of wire and cable announced last week that his sales for the first two weeks of January are well above any two weeks of May, June and July of 1923, the three months of the year that are generally considered as the best season for these commodities.

An improvement in the used-machinery trade is noticed. The greatest calls are from the steel and textile mills in New England, with some demand as far west as Ohio. One dealer reports that direct-current machinery is selling best. Few second-hand blowers and control-equipment orders are coming in, the bulk of the demand being for motors and small generators.

Supply Orders in New England Far Ahead of a Year Ago

DESPITE spotty conditions in the textile field, which it is hoped will yield to constructive legislation, general business in New England is active and electrical supply jobbers report a volume of orders in representative houses double those of a year ago. Last week a leading house took in an average of 445 orders per day. Stocks are being lowered sufficiently to require considerable replenishment from the factories. Mild weather favors deliveries.

Prices are firm, excepting recently announced declines at the factories in brass and copper products, but up to the present these had not affected jobbers' quotations much. High-tension insulators and some radio material are scarce, but most electrical supplies are plentiful. Line material continues to move at abnormally high rates for this season. Appliance sales are starting out well for the year, and the influence of new and improved retail stores is apparent.

Many of the central stations in New England are participating in an electric toaster campaign which began January 14 to run one month in co-operation with the baking interests. Money is relatively easy, and central-station expansion is proceeding rapidly. Wiring contractors are busy and electrical labor is generally well employed.

The Metal Market

ON TUESDAY of this week copper was being quoted at 12.50 cents, which is only ¼ cent more a pound than the lowest quotation of 1922. Although the low prices are bringing about some extra buying in medium quantities, there is a feeling that heavy demand will not enter the market until prices advance again. This is the opinion of authorities in the market who have watched developments for a decade.

It is thought that the wire makers have small stocks of copper in the mills and that they are due to come into the market within two weeks. Sales have not been large since November, and unless prices become firmer it is thought that hand-to-mouth buying will continue for some time.

After the zinc market made a net gain in price of $3 per ton during the week, reaching 6.45 cents, East St. Louis prices receded the last day and a half of the week to 6.40 cents for both prompt and futures. Demand from the galvanizers has slackened, and the brass makers have not been active because of the fall in copper. The gain in stocks of slab zinc in December was 5,674 tons on top of an increase of 5,117 tons the previous month.

NEW YORK METAL MARKET PRICES

	Jan. 10, 1924 Cents per Pound	Jan. 15, 1924 Cents per Pound
Copper, electrolytic	12.87½	12.50
Lead, Am.S.& R. price	7.75	8.12½
Antimony	10.00	10.00
Nickel, ingot	26.00 to 30.00	29.00 to 31.00
Zinc, spot	6.30	6.45
Tin, Straits	47.00	48.25
Aluminum, 98 to 99 per cent	27.00	26.00 to 27.00

Activities of the Trade

Devoted to News of the Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Allis-Chalmers Earnings for 1923 Show Good Year

The Allis-Chalmers Manufacturing Company report for 1923 indicates earnings of over $2,700,000 after taxes, which is equivalent to around $6 a share on the $26,000,000 outstanding common stock. Earnings in the second half were double those of the first, each month showing successive improvement over its predecessor. At current levels of around 47 and paying $4 yearly, the common stock yields about 8.5 per cent. Billings for the year will probably show an increase of about 30 per cent to well over $25,000,000, while bookage should aggregate about $31,000,000, compared with actual of $21,709,017 in 1922.

In the past eight years, with 1923 partly estimated, this company has earned a total of $61.04 a share on its common stock, equivalent to $7.74 a share yearly. Since inauguration of common dividends in 1920, it has paid a total of $15 a share, or less than one-fourth of aggregate earnings in eight years. The company is unusually well fortified with current assets. At the end of 1922 cash and government securities totaled over $10,300,000, with net quick assets of $23,838,021, which will be increased by $1,000,000, making the total equal to the $15,500,000 preferred and about $32 a share on the common stock.

General Electric Company Sales Increased 25 per Cent Over 1922

The orders received by the General Electric Company for the year ending December 31, 1923, amounted to $304,199,746, compared with a total of $242,739,527 for the year 1922, or a gain of 25 per cent, according to a recent announcement by Gerard Swope, presi-

dent. For the fourth quarter of 1923 orders totaled $74,452,442, as compared with a total of $66,568,333 for the corresponding quarter in the year 1922, or a gain of 12 per cent.

Growth in Western Electric Company Sales in 1923

For 1923 the Western Electric Company's sales billed were approximately $250,000,000 as compared with $211,000,000 for 1922, the largest previous year. Orders on hand at the end of the year were about $95,000,000, this being $33,000,000 in excess of those on hand at the end of 1922. The prospect is that a still larger business will be done in 1924.

In its electrical supply department the volume of business was larger in quantity of goods shipped than in any previous year, although somewhat less in dollars because of lower prices than in the peak year of 1920. The number of employees in this country at the end of 1923 was about 65,000, which is a high record and compares with 51,000 at the end of 1922.

New Company Plans to Operate Habirshaw Company

The creditors' committee of the Habirshaw Electric Cable Company and affiliated companies has prepared a modified plan of reorganization. This plan has been sent to the creditors and will probably be soon taken to the courts for consideration.

The formation of a new company, which shall own and operate all of the properties, is contemplated. It is proposed that the stock of the new company shall consist of 300,000 shares of common stock without par value and 450,000 shares of preferred. It has not been definitely decided whether the preferred shall be $10 a share par value or without par value. The stocks will be distributed among the creditors in proportion to their claims.

Ground Coal Engineering Corporation Changes Name

Milton W. Arrowood announces that he has purchased all the interest held in his company by the Sanford Riley Stoker Company since December 22, 1922. The business known during the past year as the Ground Coal Engineering Corporation will now be operated by Mr. Arrowood and his associates in Chicago, who have been connected with the organization since its inception in 1917, at which time the original partnership was founded. Until its incorporation in 1922 it was known as the Ground Coal Engineering Company.

The corporate name has now been changed to "Universal Engineers, Inc." Pending the establishment of offices in New York and Chicago, the address of the company will be 2 Downing Street, Worcester, Mass.

Underwood to Represent O. C. White in Philadelphia-Washington

L. B. Underwood, 139 North Fourth Street, Philadelphia, has been appointed representative of the O. C. White Company, Worcester, Mass., manufacturer of adjustable electric lighting fixtures. He will maintain a supply of samples and stock in Philadelphia and will also cover the Reading, Baltimore and Washington districts. The company has recently issued a new folder entitled "The Trend of Industrial Lighting," bringing out as new features styles for drafting board and other extended work and a series of bases for conduit systems applicable to the company's line of ceiling, wall and bench adjustable fixtures.

General Electric Denies Rumor of Purchase

The General Electric Company, Schenectady, N. Y., from its New York City office, has denied the report that it was about to acquire the Bath Iron Works, Bath, Me., as an auxiliary plant. It was stated that the Bath plant was being sought by the General Electric in the interest of the extension of its turbine building plant.

Record-Breaking Demand for Electric Furnaces

Inquiries for electric furnace equipment since January 1 have exceeded previous experience in volume, according to K. A. Juthe, president American Metallurgical Corporation, Boston. "At present," said Mr. Juthe, "we have inquiries on our desks for furnaces totaling about $250,000, and applications are broadening rapidly. Raw materials are plentiful and the prospect is most encouraging." Within the past few days the Pratt & Whitney Company, Hartford, has purchased a 15-kw. lead pot; the Imperial Knife Company, Providence, has ordered a box-type furnace of the same rating, and tests have just been scheduled on a 100-kw., 4x9-ft. vitreous-enameling furnace at the plant of A. B. Chapman, Taunton, Mass. The unusual demand for electric furnaces is due to the activities of central-station power engineers, who are emphasizing industrial electric heating to an increasing degree.

Chicago Pneumatic Tool Now Manufacturing Its Electrical Equipment

The Chicago Pneumatic Tool Company started 1924 with plants operating at close to capacity. Of the three main plants Detroit showed the highest percentage of operation. The Franklin plant is running at about 85 per cent of capacity. At the Cleveland plant the percentage of operation cannot be accurately estimated owing to the fact that since the latter part of 1923 production of electrical machines has been started for the first time. While the company has been producing electrical machines allied with its other lines of pneumatic machinery and tools, the electric devices were produced by other manufacturers under the company's supervision. Production is now entirely in the hands of the company and is to be on a fairly large scale.

Fitzgerald Company Enlarges Torrington Plant

The Fitzgerald Manufacturing Company, Torrington, Conn., manufacturer of electrical household specialties, has awarded contracts for an addition to its factory at Torrington, to be approximately 300 ft. long and two stories high. According to present plans, the building will be ready for occupancy April 1.

This addition to the company's Torrington plant and several enlargements to the Winsted factory were made necessary by the increase in the company's business.

Westinghouse to Add New Unit to California Factory

A second factory unit, to cost $500,000, is to be added to the plant facilities of the Westinghouse Electric & Manufacturing Company on its 12-acre tract in Emeryville (Oakland), Cal., according to announcement by C. E. Heise, district manager. The new building will provide accommodations for a large assembling shop, extensive service and repair shops, a zone warehouse and various other facilities. The building will be three stories high and will occupy a ground space 200 ft. wide by 245 ft. long.

The company recently completed a factory at the same location for the manufacture of high-tension and other porcelain insulators.

The Locke Insulator Corporation, Baltimore, will erect a one-story brick building, 81 ft. x 122 ft., at Charles and Cromwell Streets, at a cost of $15,000.

The Service Maid Corporation, 308 North Michigan Avenue, Chicago, has been organized to manufacture electrical dishwashing machines. The company plans to have a factory of its own complete for operation within six months.

The Williamsburg Electric Supply Company, 636 Broadway, Brooklyn, N. Y., recently incorporated with $100,000 capital stock, will manufacture and distribute electrical wiring supplies.

The Wurldsbest Ventilator Company, 170 Fifth Avenue, New York City has been incorporated with $150,000 capital stock to manufacture ventilators and electric ventilating equipment. Production is being handled through contract for the present. The company expects to manufacture approximately 300,000 ventilators during the coming year. R. B. Respess heads the company.

The G. & W. Electric Specialty Company, Chicago, has purchased property, 125 ft. x 389 ft., at Anthony and Kimbark Avenues, for a consideration of $24,500 and will use the site for a new plant, for which plans will be drawn at a later date.

The Antenna Insulator Company, 15 Bagley Street, Pawtucket, R. I., has been organized to manufacture weatherproof insulators. The company is now machining insulators for the Continental Fibre Company, Newark, Del. L. H. Bean is president.

The Michigan Electric & Manufacturing Company, Lake Linden, Mich., has been organized with $75,000 capital stock to manufacture fractional-horsepower motors and other electrical products. Physical assets and the plant of the Calumet Motor Company have been purchased. F. C. Perry is president and general manager of the new company.

The Crescent Insulated Wire & Cable Company, Olden and Taylor Streets, Trenton, N. J., and the Crescent Armored Wire Company of the same city, affiliated, have filed articles of incorporation in Illinois, retaining their New Jersey charters, with total capitalization of $1,500,000, for expansion in this section. C. Edward Murray and A. H. Battye are president and secretary respectively of both organizations.

The Rigsbee Electric Company, 1800 Main Street, Dallas, Tex., has tentative plans for the rebuilding of the portion of its works destroyed by fire on Dec. 11, with loss estimated at $25,000.

The H. T. Electric Company, 612 North Capitol Avenue, Indianapolis, will soon take bids for the erection of a new plant to cost approximately $30,000, for which plans have been drawn by Edward D. Pierre, Hume-Mansur Building, architect.

The National Light & Electric Company, 291 Market Street, Newark, N. J., electrical specialties, has purchased property at 61-63 Lafayette Street, 36 ft. x 60 ft., adjoining a four-story building at 57-59 Mulberry Street, acquired a number of months ago, and will use this property for expansion in its works.

The Boston Electrical Heating Company, Boston, recently organized, has taken over a portion of the factory of the G. G. Roberts Corporation, South Avenue, Whitman, Mass., under lease, and will operate a local plant for the manufacture of electric heating appliances for shoe factories. Fred Drew and Charles Lowell head the company.

The Interflash Signal Corporation, 120 Broadway, New York, has leased a portion of the building at Plane and Augusta Streets, Newark, N. J., and will equip for a new plant for the manufacture of signal devices.

The Miller-Seldon Electric Company, 1259 Park Street, Detroit, manufacturer of electric equipment and appliances, is about to commence the erection of a new three-story plant on McGraw Street, near Vermont Street, to cost approximately $80,000.

The Line Hardware Manufacturing Company, 18,222 Oakview Road, Cleveland, manufacturer of pole-line hardware, has been organized by J. D. Hoit, formerly connected with the Electrical Materials Corporation, which is no longer in existence.

The King Lamp & Manufacturing Company, Hudson Reed Building, New York City, has been organized to manufacture and distribute electric lamps, fixtures and devices.

The Crocker-Wheeler Company, Ampere, N. J., has disposed of its foundry property at the foot of Rome Street, Newark, N. J., purchased during the war for the production of gray-iron castings. It has not been in active service for some time past.

The Westinghouse Electric International Company has recently appointed R. F. Hamilton as its manager for the west coast of South America. He succeeds R. A. Wrench and sailed for Santiago on January 5 to take up the duties of his new office.

The Capital Electric Company, Salt Lake City, Utah, has sold out its entire automotive accessory stock, excepting Gould batteries, Tungar battery chargers and Edison miniature Mazda lamps, to the Covey-Ballard Wholesale Company of this city. The business of the Capital Electric Company will henceforth be exclusively that of wholesaling of electrical supplies. A growing volume of business and consequent need of greater storeroom facilities for the company's major line are the reasons for the change.

New Equipment Available

Short Descriptions of New Apparatus and Accessory Equipment of Interest to the Electrical Industry and Available from Manufacturers and Announcements of New Lines

Steel Frame Switchgear for 6,600 Volts

A new type of three-phase ironclad 6,600-volt, 250-amp. switchgear has been introduced by the firm of George Ellison, Birmingham, England. The arrangement consists of a busbar chamber constructed of angles and steel plate and carried on a series of vertical tubular members, which are provided with cast-iron feet. In front of each set of four tubular members, which support a single unit of the gear, there are two vertical screws. The rotation of these screws lowers the switch as a whole until it is completely disconnected from all high-tension gear, and after this lowers the oil tank independently so that the contacts are exposed. The bus bar chamber is divided horizontally into two parts, the upper part forming the busbar chamber proper. The lower part is an isolating plug chamber and contains a series of insulators carrying plugs which make contact with the oil-switch terminal stems when the switch is in the top position. As the switch is lowered the plugs are withdrawn and the switch is rendered dead. An insulating slide operated by the oil-switch lowering mechanism slides over the ends of the insulating tubes which the switch terminal stems enter when in their top position, so that when the switch is lowered no live metal is exposed. The lowering mechanism is interlocked with the oil-switch operating handle, so that the switch cannot be lowered unless it is in the open position and the circuit consequently cannot be broken on the isolating plugs.

Vitrohm Speed Regulator.—A speed regulator with imbedded resistor has been developed and placed on the market by the Ward Leonard Electric Company, Mount Vernon, N. Y. The regulator is designed for constant torque, direct-current, 115-volt or 230-volt motors up to ½ hp. and up to ¾ hp. variable torque. The regulator may be purchased either fully inclosed or with exposed contacts.

Motors. — A line of alternating-current and direct-current 40-deg. motors has been placed on the market by the Champion Electric Company, 3711 Forest Park Boulevard, St. Louis. The line includes polyphase motors from ¼ hp. to 20 hp., single-phase from ¼ hp. to 5 hp., split-phase from ¼ hp. to ½ hp., and direct current machines from ¼ hp. to 2 hp.

Storage Battery.—A 6-volt, three-cell storage battery of the demountable type with current capacities ranging from 60 amp. to 150 amp. has been placed on the market by the Demountable Battery Corporation, 429 Kent Avenue, Brooklyn, N. Y. Mechanical joints are used to hold the plates together, and all connections consist of threaded ends that screw into corresponding threaded sockets. A cushion suspension is provided to relieve the plates of any jarring action.

Crawler-Thread Loader.—A crawler-thread power-swiveling industrial loader recently put on the market by the Link-Belt Company, Philadelphia, is capable of cutting a path 20 ft. wide through a pile of coal or other material. It is claimed that 45 cu.ft. of coal can be handled per minute. A feature of this loader is the crawler tread which makes possible its use under almost any yard condition. The loader can back into, dig, swivel and elevate at the same time or can do any of these operations independently.

New Trade Literature

WATERWHEEL GENERATORS. — Bulletin No. 1,127 issued by the Allis-Chalmers Manufacturing Company, Milwaukee, contains illustrations showing various installations of its waterwheel generators.

HEAT INSULATION.—The Philip Carey Company, Lockland, Ohio, is distributing bulletin 101, entitled "High Temperature Heat Insulation," which is the first of a series of technical bulletins on the performance and adaptability of heat-insulating materials.

ELECTRIC SIGNALING DEVICES.—Edwards & Company, Inc., 140th and Exterior Streets, New York City, has issued catalog No. 9, covering its products, including electric signaling devices, bells and buzzers, annunciators, fire alarms, etc.

ELECTRIC MEASURING INSTRUMENTS.—The Eldridge Electric Manufacturing Company, Springfield, Mass., is distributing bulletins covering the "Eldridge" pocket-type ammeters, voltmeters, volt-ammeters, miniature-panel flush mounting ammeters and voltmeters, spark-coil current indicator and model W-444 ammeter.

WELDING AND CUTTING APPARATUS.—The Alexander Milburn Company, 1416-28 West Baltimore Street, Baltimore, has issued a catalog covering its welding and cutting apparatus. The company is also distributing a catalog describing the "Milburn" carbide light for contractors, railways, mines and quarries.

CONVEYOR.—The Victor Engineering Company, Inc., Philadelphia, has issued a booklet describing the "Victor" jet conveyor for ashes, clinkers, combustion slag, coke, etc.

LIGHTING SPECIALTIES.—The F. W. Wakefield Brass Company, Vermilion, Ohio, has issued new and revised data sheets on its "Red Spot" lighting specialties.

TRANSMISSION MACHINERY.—Catalog No. 21 issued by Winfield H. Smith, 10-16 Lock Street, Buffalo, describes and illustrates its line of light power-transmission machinery.

ALLOYS.—"Nichrome and Other Alloys for Electrical Resistance" is the title of a booklet issued by the Driver-Harris Company, Harrison, N. J., in which it describes its alloy products and their use. It also contains charts showing temperature resistance curves and charts showing change in resistance with temperature.

ELECTRICAL SUPPLIES.—The Hart & Hegeman Manufacturing Company, Hartford, Conn., is distributing its new general catalog "R."

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An agency is desired in Glamorganshire, Wales (No. 8,832), for electrically operated refrigerators for domestic and hotel use.

Purchase and agency is desired in Bilboa, Spain (No. 8,830), for electrical household appliances of all kinds and electric drills for wood and metal.

Purchase is desired in Johannesburg, South Africa (No. 8,828), for radio sets and accessories; also for domestic electric refrigerators (No. 8,827). Purchase and agency is also desired (No. 8,829) for radio sets and accessories.

Purchase is desired in Berlin, Germany (No. 8,865), for airplane motors and instrument boards, searchlights, sirens and rockets.

TENDERS FOR TRANSFORMERS FOR MORWELL (AUSTRALIA) POWER SCHEME.—Tenders will be received by the State Electricity Commission of Victoria, Melbourne, Australia, until Feb. 11, specification No. 24/4-4, for 100-kva., 25,400/6,600-volt transformers and spares. For details see Searchlight Section.

ELECTRIC POWER STATION PROPOSED FOR ARGENTINA OIL FIELDS.—The Argentine State Oil Fields Administration, Buenos Aires, Argentina, it is reported, will receive tenders until March 21 for the construction of a 12,500-kw. power station at Comodoro Rivadavia.

ELECTRIC SHOW IN MELBOURNE, AUSTRALIA.—An electrical exhibition under the auspices of the Victoria Electrical Federation, according to Assistant Trade Commissioner F. G. Pauly, will be held in Melbourne, Australia, during September, 1924. It is planned to cover every phase of the industry, showing actual working models of the various types of apparatus from toys to machinery, transport, lighting and other industrial equipment. Both wireless telegraphy and wireless telephony will have prominent places in the exhibition. Further particulars may be secured from Edward Perugini, general manager Victoria Electrical Federation, Melbourne, Australia.

New Incorporations

THE OAK RIDGE LIGHT & POWER COMPANY, Mooresville, N. C., has been incorporated with a capital stock of $50,000 by Carl Walters and others.

THE FAIRVIEW (W. VA.) ELECTRIC LIGHT & POWER COMPANY has been chartered with a capital stock of $25,000 by T. H. Toothman, C. S. McElroy and others.

THE ROYAL RIVER MANUFACTURING & POWER COMPANY, Boston, has been incorporated by John Calder, James M. Swift and Walter S. Beatty, Lexington, Mass. The capital stock consists of 2,000 shares of no par value.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

LEWISTON, ME.—The Androscoggin Electric Company is arranging a bond issue of $591,000, part of the proceeds to be used for extensions and improvements.

MEREDITH, N. H.—The Utilities Power Company has been granted permission to erect a transmission line across state-owned property in Ashland and Meredith. The proposed transmission line is to be used in connection with the power development under way on the Pemigewasset River.

SPRINGFIELD, MASS.—Among the improvements contemplated by the United Electric Light Company is the construction of an underground 13,000-volt transmission line from the State Street power plant to Indian Orchard, to cost about $100,000.

LITCHFIELD, CONN.—The Litchfield Electric Light & Power Company is planning to extend its lines along the Woodbury Road.

Middle Atlantic States

BATAVIA, N. Y. — The Western New York Utilities Company, Inc., plans to build a power plant on Franklin Street.

ELLENVILLE, N. Y.—The United Hudson Electric Corporation, Poughkeepsie, is planning to take over the property of the Honk Falls Power Company, including hydro-electric plants at High Falls and Napanoch, and steam plant at Eddyville. Extensions and improvements, including additional transmission lines, are contemplated.

FORT ANN, N. Y.—The Kanes Falls Electric Company has been authorized to transfer its franchises and system in Granville Township to the Adirondack Power & Light Corporation. The transfer is for the purpose of betterments and additional facilities for electrical development.

HORSEHEADS, N. Y.—The Consolidated Brick Company is considering rebuilding its plant and power house, recently damaged by fire, causing a loss of about $200,000.

NEW YORK, N. Y. — Electric power equipment will be installed in the service and mechanical repair plant to be erected at Avenue C and Sixteenth Street by the Department of Plant and Structures, to cost about $3,500,000.

NEW YORK, N. Y.—Bids will be received by the commission of water supply, gas and electricity, Room 2351, Municipal Building, until Jan. 24 for furnishing and installing light equipment, including fixtures for the 197th Street pumping station and warehouse, borough of Manhattan. Bids will also be received for furnishing and installing an electric lighting system at the Jerome Avenue pumping station, borough of the Bronx.

NEW YORK, N. Y.—Bids will be received by William H. Gompert, architect, board of education, Flatbush Avenue Extension and Concord Street, Brooklyn, until Jan. 25 for electric wiring and fittings, and gas and electric fixtures in the George Washington High School, borough of Manhattan. Bids will also be received for installing electric wiring and fittings, and installing gas and electric fixtures in new Public School 210, borough of Brooklyn.

NEW YORK, N. Y. — Electric power equipment, etc., will be installed in the printing and publishing plant to be erected at Ninth Avenue and Thirty-fourth Street by the Pictorial Review Company, 222 West Thirty-ninth Street, to cost about $6,100,000. Renwick, Aspinwall & Tucker, 8 West Fortieth Street, are architects.

NEW YORK, N. Y.—The New York Edison Company has purchased the power house property of the New York Railways Company on First Avenue. The plant will eventually be remodeled and used as a power plant by the former company.

PANAMA, N. Y.—Permission has been granted to the Western New York Electric Company to extend its electric system to Panama to furnish electricity for lamps and motors.

PORT LEYDEN, N. Y.—A movement is on foot to establish a municipal electric plant. It is proposed to take over the local electric plant, which will require some improvements to enable it to give adequate service.

BRIDGETON, N. J.—The Electrical Company of New Jersey has secured permission to issue $643,200 in bonds, part of the proceeds to be used for extensions.

CAMDEN, N. J.—The Joseph Campbell Company plans to build a power house at the proposed addition to its plant, to cost about $700,000.

KEASBEY, N. J.—The National Fireproofing Company, Fulton Building, Pittsburgh, plans to build a power house in connection with the rebuilding of its local plant, recently damaged by fire with loss of about $400,000.

DELANO, PA.—The Pennsylvania Power & Light Company plans to erect a transmission line to Delano, Park Place, Grier City, Lakewood and vicinity, for commercial light and power service.

EDGELY, PA.—The Philadelphia Suburban Gas & Electric Company is planning to build a large power plant here.

ERIE, PA.—The City Council is considering installation of a high-tension conduit system in West Twelfth Street, to cost about $23,000. Work will soon be started on an extension to the ornamental lighting system on State Street. The installation of a new lighting system on Peach Street, between Fifteenth and Eighteenth Streets, is also under consideration.

HANOVER, PA.—The Dale Electric Company, now being organized, plans to erect a transmission line in West Hanover and Dauphin Townships. John E. Snyder, Harrisburg, represents the company.

PHILADELPHIA, PA.—Bids have been taken by the Ford Motor Company, Detroit, for the construction of its proposed assembling plant and power house to be erected on Sixty-third Street, to cost about $500,000. Albert Kahn, 1000 Marquette Building, Detroit, is architect.

PHILADELPHIA, PA. — The Philadelphia Electric Company plans extensions and improvements to its substation at Fifty-sixth and Race Streets. John T. Windrim, Commonwealth Building, is architect.

PHILIPSBURG, PA.—Bids will be received by the trustees of the State Hospital until Jan. 25 for the construction of a power house at the institution. George S. Idell, 1705 Chestnut Street, Philadelphia, is architect.

MIDDLETOWN, DEL. — The Light & Water Board has authorized extensions and improvements to the municipal electric plant.

WILMINGTON, DEL.—The Wilmington & Philadelphia Traction Company plans to install an ornamental lighting system on West Ninth, Tenth and Eleventh Streets and Delaware Avenue.

BALTIMORE, MD. — The construction budget of the Consolidated Gas, Electric & Power Company for 1924 provides for an expenditure of about $8,000,000. The work will include the construction of a new 60,000-hp. steam-driven electric plant at Gould Street and at Dundalk, transmission lines, etc.

CLARKSBURG, W. VA.—The Monongahela-West Penn Public Service Company plans to build a local substation to cost about $75,000.

NORFOLK, VA.—Improvements are contemplated by the Virginia Railway & Power Company, to cost about $550,000. The work includes the installation of a 15,000-kw. alternator, substituting underfeed for overfeed mechanical stokers and the construction of a substation at Fairmont Park, etc.

WASHINGTON, D. C.—Bids will be received by the chief of engineers, United States Army, Munitions Building, until Jan. 28, for motor-driven ventilating sets.

WASHINGTON, D. C.—Bids will be received by the Chief Signal Officer, United States Army, until Jan. 26 for one set switchboard tools, one switchboard, four battery elements, one power board complete, eight terminal lugs, one cable rack, three cut-outs and one test table (Circular C. P. 15933-A-2); also, until Jan. 25 for 265 transformers and 150 transformers, radio frequency (Proposal 16151-A1).

North Central States

COLUMBIAVILLE, MICH. — Plans for rebuilding the mill of the Columbiaville Woolen Mills, Inc., recently destroyed by fire, include a power plant. The loss is estimated at about $100,000.

AKRON, OHIO. — The Northern Ohio Traction & Light Company is planning to build an addition to its Gorge power plant, to cost about $300,000.

CHILLICOTHE, OHIO. — A committee has been appointed by the Council to make investigations relative to the installation of cluster lamps on the main streets of the town.

CAVE CITY, KY.—The Kentucky Utilities Company plans extensions and improvements to the street-lighting system.

LOUISVILLE, KY. — Permit has been granted to the Louisville Gas & Electric Company for the erection of a transformer station at Thirteenth and Magazine Streets, to cost $25,000.

HAMMOND, IND.—The Erie Railroad Company, 50 Church Street, New York, contemplates the construction of a power house at its proposed local car and locomotive repair shops, to cost about $500,000.

HAZLETON, IND.—The Public Service Commission has instructed the Hazleton Electric Light Company to make changes in its electric distribution system to enable it to render adequate service to its patrons.

ST. PAUL, IND.—Plans are under way for the construction of a dam on the Flat Rock River at St. Paul, to cost about $500,000, for a hydro-electric plant. John A. Shafer, Indianapolis, is architect and engineer.

WHITING, IND.—The Standard Oil Company of Indiana, Indianapolis, has tentative plans for rebuilding its refinery and power house, recently damaged by fire, with loss of about $750,000.

GRANITE CITY, ILL. — The Illinois Power & Light Company has acquired a local site for a substation.

PLYMOUTH, ILL.—Plans for the proposed local stone-crushing plant, to cost about $150,000, include a power house. F. M. Connolly, Galesburg, is architect in charge.

VENICE, ILL. — The Illinois Power & Light Corporation, Illinois Merchants' Bank Building, Chicago, has applied for permission to erect a transmission line from Venice to Caseyville.

ALBANY, WIS.—The Wisconsin Utilities Company has acquired the property of the Albany Electric Light & Power Company and plans to extend its high-transmission line from Brodhead to Albany, a distance of 10 miles.

ALMOND, WIS.—Negotiations, it is reported, are under way between the Almond Electric Company and the Wisconsin Power, Light & Heat Company, Madison, for the extension of the high-tension line of the latter company from Wautoma to Almond, a distance of 20 miles, to furnish electricity here. The power house of the Almond company was recently destroyed by fire.

COLBY, WIS. — The installation of an ornamental lighting system in the business district is under consideration by the City Council.

NECEDAH, WIS.—The Village Board is considering installing a new lighting system in the business district.

NECEDAH, WIS.—The Middle Wisconsin Power Company, Tomah, has purchased the electric plant and distributing system of the Necedah Milling & Electric Company. The new owner plans to extend its high-tension line from New Lisbon to Necedah, a distance of about 20 miles.

POTOSI, WIS. — The municipal electric distribution system has been acquired by the Interstate Light & Power Company, Platteville. Extensions and improvements will be made to the local system.

RACINE, WIS.—The City Council is considering the construction of a power plant at Cedar Bend.

SHOREWOOD, WIS.—The Village Board has authorized a survey made of the section of the village west of Oakland Avenue to the Milwaukee River, with a view of installing an electric lighting system. At present the district is not lighted with electricity.

SOLDIERS' GROVE, WIS.—The Soldiers' Grove Electric Light & Power Company contemplates extending its transmission lines into the rural districts throughout the surrounding territory to furnish electricity to farmers.

DULUTH, MINN.—The Minnesota Light & Power Company is considering an appropriation of $15,000,000 for extensions and improvements during the next thirty-six months, of which about $7,000,000 will be used during 1924. The work includes the construction of a hydro-electric plant in the Vermilion Lake section, near Ely; generating plants at Cloquet and Scanlon, Minn., and a 110,000-volt transmission line from Little Falls power plant to Nashwauk.

MINNEAPOLIS, MINN.—Plans for the proposed local mills of the Fulton Bag & Cotton Mills, Inc., Atlanta, Ga., to cost about $700,000, include a power house. Frederick Kees, Plymouth Building, is architect.

SLAYTON, MINN.—The Northern States Power Company, Minneapolis, has acquired the electric plant of the Slayton Power Company and plans improvements to the system, to cost about $6,000. The company is erecting a transmission line to Iona.

TOWER, MINN.—The Council is considering plans for remodeling the municipal hydro-electric power plant, including the installation of additional equipment.

GARNER, IOWA.—The City Council has decided to call a special election to submit a proposal to the voters offering to grant a twenty-five year franchise to a party to install and operate an electric light and power plant in Garner. The franchise of the company now supplying electric service in the city has expired.

CLERKSVILLE, MO. — The La Crosse Lumber Company is planning to rebuild its mill and power house, recently damaged by fire. The loss is estimated at about $50,000.

JEFFERSON CITY, MO. — Permission has been granted to Clark E. Jacoby and Eugene L. William to construct a power dam on Gasconade River, just above the Rich Fountain Bridge.

KANSAS CITY, MO.—The Central Missouri Power & Water Company has applied for a permit to develop two power projects on the Gasconade River, one near Vienna and the other near Waynesville.

NORBORNE, MO.—The proposal to issue $110,000 in bonds to purchase the local electric plant and to enlarge the water and sewer systems is under consideration by the Council.

OAKES, N. D. — The Ottertail Power Company, Fergus Falls, Minn., plans to erect a transmission line from Cogswell.

BLUE SPRINGS, NEB.—A franchise has been granted the Black Brothers Flour Mills Corporation to erect a transmission line through the municipality.

BURDEN, KAN.—The Council is considering a bond issue of $15,000 for the erection of a transmission line for municipal service. W. B. Rollins & Company, Railway Exchange Building, Kansas City, Mo., is engineer.

Southern States

ASHEVILLE, N. C.—The North Carolina Electrical Power Company plans extensions in the transmission system of the Biltmore Development Company, recently acquired.

RUTHERFORDTON, N. C. — Plans are being considered by the Chimney Rock Development, Inc., for a hydro-electric development.

WARSAW, N. C.—The Tidewater Power Company, Wilmington, has acquired the municipal electric light plant and will supply electricity for the local system from its high-tension lines.

NEWBERRY, S. C.—The new municipal pumping station and high-service station, it is reported, will be equipped with electrically operated pumps.

COLUMBUS, GA.—The Columbus Electric & Power Company plans to build a hydro-electric plant at the Goat Rock dam, to cost about $5,000,000. Additional transmission lines will be erected.

SAVANNAH, GA.—The Central of Georgia Railway plans to build a power house in connection with rebuilding of its local car repair shops, to cost about $400,000. Bids, it is understood, will be called in February.

BLOUNTSTOWN, FLA.—Plans are under way for the installation of a lighting system, for which bonds have been issued.

JACKSONVILLE, FLA. — The Cheek-Neal Coffee Company plans to build a power house at its proposed local plant, to cost about $300,000.

ORLANDO, FLA.—Bonds to the amount of $525,000 have been voted for improvements to the municipa' electric light plant and waterworks system.

TAMPA, FLA.—At an election to be held Feb. 12 the proposal to issue $100,000 in bonds for fire station, fire-alarm systems and equipment will be submitted to the voters.

CHATTANOOGA, TENN.—The Southern Cities Power Company, it is reported, has acquired the systems of the Mount Pleasant (Tenn.) Electric Company and the Harpeth Electric Light & Power Company, Franklin. Improvements contemplated by the Southern Cities company include remodeling the hydro-electric plant at Columbia, the erection of a high-tension line from Farmington to Columbia and connecting Franklin with the present line ending at Spring Hill. The company also contemplates the erection of electric stores in Mount Pleasant, Franklin and Lewisburg.

CLEVELAND, TENN.—The construction of a power plant, to cost about $40,000, at the Cleveland Woolen Mills is under consideration. The equipment will include a 500-kw. generator and auxiliary equipment.

FLORENCE, ALA.—Bids will be received at the United States Engineers Office, Florence, about Feb. 1 for four 35,000-hp. turbines for the Wilson Dam plant.

LITTLE ROCK, ARK. — The Monarch Mill & Lumber Company plans to build a power house at its plant.

MELVILLE, LA.—Bids will be received by the Mayor and Board of Aldermen until Jan. 29 for improvements to waterworks, including two crude-oil engines directly connected to alternators, motor-driven service pump, 500-gal. fire pump, steel tank and tower, reservoir, new building, pipe, hydrants, etc. Swanson-McGraw, Inc., United Fruit Building, New Orleans, is engineer.

NEW IBERIA, LA. — Bonds to the amount of $250,000 have been voted for improvements to the municipal electric light plant and waterworks system and for building a road to the sea.

DALLAS, TEX.—The Council is considering plans for electric traffic system for residence streets, to cost about $25,000. E. A. Kingsley is city engineer.

FORT WORTH, TEX.—The Council is considering installing street lamps in Rosen Heights, to cost $30,000; in Arlington Heights, $30,000, and miscellaneous street lamps, $25,000. D. L. Lewis is city engineer.

HOUSTON, TEX.—The Council plans to extend the electric traffic control system to three additional streets, to cost $25,000. J. C. McVea is city engineer.

KAUFMAN, TEX.—Permission has been granted to the Big State Oil Corporation, Dallas, by the State Board of Water Engineers for the construction of a dam on Cedar Creek for power development purposes.

MALAKOF, TEX.—The Texas Power & Light Company, Dallas, is planning to erect a transmission line to supply electrical service here.

MEXIA, TEX.—The installation of an ornamental lighting system in the business section is under consideration.

SAN ANTONIO, TEX.—Tentative plans are under consideration by the San Antonio Public Service Company for improvements in the electrical department during 1921 as

follows: Extension and improvements to plants, to cost $417,000; overhead distribution lines, $150,000; transformers, $50,000; meters, $47,300, and street lamps, $47,700.

Pacific and Mountain States

ABERDEEN, WASH.—The Gray's Harbor Railway & Light Company has applied to the Federal Power Commission for water rights on the Wynooche River for power purposes.

SPOKANE, WASH. — The Washington Water Power Company has appropriated $2,000,000 for extensions and improvements in its system during 1924. Work will soon begin on the erection of a 110,000-volt transmission line from Spokane to Long Lake and from there to Stratford. A line will also be built from Nettel to Taunton.

TACOMA, WASH. — The City Council has authorized the installation of an improved street-lighting system on Nineteenth Street from Cedar to Junett Streets; also on North Oak Street from Sixth Avenue to North Twenty-first Street.

TACOMA, WASH.—Changes have been made in the original plans for the construction of the Lake Cushman project of the city of Tacoma, under which two storage dams and two power plants will ultimately be developed instead of one. Under the new plan one power house will be built just below the dam in the North Fork of the Skomomish River, operating under a head of 275 ft. The water will be caught and again impounded by the Potlatch dam, 2 miles further down the stream, and carried by a concrete tunnel through a hill, about 2½ miles, to the forebay and penstocks directly above the canal. The power house will be located below on the shores of the Hood Canal, about ½ mile from Potlach. The plans provide for an initial development of 50,000 hp., to cost about $5,250,000, with an ultimate development of 140,000 hp., to cost $10,000,000.

METOLIUS, ORE.—The Columbia Valley Power Company is planning to build a hydro-electric plant at the junction of Deschutes and Crooked Rivers to develop about 175,000 hp.

NORTH BEND, ORE. — The Mountain States Power Company plans to build a local power plant with an initial capacity of 5,000 kw., to cost about $600,000.

CORONA, CAL.—Steps have been taken for the installation of a street-lighting system on Sixth Street from Belle Avenue to Buena Vista Street.

FRESNO, CAL.—The San Joaquin Light & Power Corporation contemplates an expenditure of $6,000,000 for extensions and improvements to its system during 1924, of which about $550,000 will be used for additional substations.

MODESTO, CAL.—Plans and specifications for the complete Don Pedro power system to cover the Modesto Irrigation project have been approved by the board of directors, and the secretary has been authorized to call for bids for construction work.

SAN FRANCISCO, CAL.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 5 for power-plant equipment for Mare Island navy yard (Schedule 1788), and for five storage batteries (Schedule 1772).

Canada

CHEMANIUS, B. C.—The Victoria Lumber & Manufacturing Company, Victoria, plans to build a power house at its proposed local mill, to cost about $7,000,000. All machinery will be electrically operated.

MIDDLETON, N. S.—The Town Council plans to install an additional generating unit at the hydro-electric plant at Nictaux Falls, to cost about $30,000.

LEAMINGTON, ONT.—Plans have been approved by the Hydro-Electric Power Commission of Ontario (Essex County system) for the erection of a tie line from Belle River to Essex.

MORRISBURG, ONT.—The Hydro-Electric Power Commission of Ontario, Toronto, is planning to develop about 15,000 hp. on the St. Lawrence River at Morrisburg, to cost about $2,000,000. The work will include dam, canal, power house, etc.

ST. AUGUSTIN, QUE.—Plans for the proposed local pulp and paper mill to be erected by the St. Regis Paper Company, Watertown, N. Y., to cost about $3,000,000, include a power plant.

Electrical Patents

Announced by U. S. Patent Office

(Issued Dec. 25, 1923)

1,478,579. COUPLER FOR RADIO RECEPTION; E. M. Reynolds, Cleveland, Ohio. App. filed May 15, 1922. Horseshoe-shaped secondary rotates inside of primary.

1,478,607. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; C. L. Goodrum, New York, N. Y. App. filed Dec. 31, 1919. Method by which toll operator may check number given over automatic switches.

1,478,638. ELECTRIC OSCILLATOR; H. G. Cordes, Bremerton, Wash. App. filed May 10, 1917. Adapting arc oscillator to the production of variable-frequency oscillation for radio telephony.

1,478,663. RAILROAD CROSSING SIGNAL; W. B. Kuhn, Shelby, Ohio. App. filed Aug. 22, 1922. Automatically indicates approaching train.

1,478,665. BRUSH RIGGING; T. L. Lee, Rochester, N. Y. App. filed March 9, 1922. Method of holding brush by spring.

1,478,701. CONTROLLER; F. Diehl, Elizabeth, N. J. App. filed Feb. 10, 1919. Rheostat for sewing-machine motor operated by foot.

1,478,708. PROCESS OF MANUFACTURING STORAGE BATTERIES; K. W. Gasche, Pittsburgh, Pa. App. filed July 6, 1920. Method of assembling plates.

1,478,709. TUNED TELEPHONE RECEIVER; H. Gernsback, New York, N. Y. App. filed March 17, 1923. Making characteristics for two receivers of a headset identical.

1,478,713. ELECTRIC MOTOR CONTROLLER; L. Kebler, Bronxville, N. Y. App. filed April 1, 1920. Automatic control and protection.

1,478,714. LIQUID-TREATING APPARATUS; C. P. Landreth, Philadelphia, Pa. App. filed Aug. 7, 1922. Method of purifying liquids by electric current.

1,478,738. WELDING ELECTRODE; C. J. Holslag, South Orange, N. J. App. filed May 22, 1922. Contains considerable manganese.

1,478,786. METHOD OF ASSEMBLING STORAGE-BATTERY ELEMENTS; C. W. Hazelett, Lakewood, Ohio. App. filed Jan. 24, 1922. Series of batteries may be connected as unit.

1,478,806. METHOD OF DELIVERING ILLUSTRATED LECTURES OR SONGS; A. F. Victor, New York, N. Y. App. filed March 1, 1922. Combined radio receiving set and stereopticon lantern.

1,478,822. METHOD OF AND APPARATUS FOR DECOMPOSING ORES; J. D. Gat, Canton, Ohio. App. filed Feb. 2, 1921. In electric furnace.

1,478,845. ELECTRIC FUSE, HEATING ELEMENT AND THE LIKE; A. F. Berry, London, England. App. filed Aug. 24, 1920.

1,478,853. ANODE AND CARRIER THEREFOR; H. L. Haas, New York, N. Y. App. filed Sept. 17, 1920. For electroplating cells.

1,478,857. AUTOMOBILE SIGNAL; C. Hoffman, Allentown, Pa. App. filed March 31, 1923. Direction signal operated from steering wheel.

1,478,859. METHOD AND APPARATUS FOR INSERTING SUPPORT WIRES; F. C. Ingold, Bloomfield, N. J. App. filed July 21, 1921. Construction of electric light bulbs.

1,478,870. LIGHTING FIXTURE; C. J. Drees, Little Rock, Ark. App. filed Aug. 18, 1920. Switch arrangement for fixtures close to ceiling.

1,478,912. INSULATOR; B. A. Plimpton, Lima, N. Y. App. filed Nov. 8, 1920. Sectional-type pin insulator.

1,478,919. THERMO-ELECTRIC HEAT-ACCUMULATING COOKING STOVE; S. Sacerdote and S. Cristiani, Milan, Italy. App. filed March 24, 1921. Holds heat similar to fireless cooker.

1,478,972. ROAD SIGNAL; C. E. Lyman, Asheville, N. C. App. filed April 18, 1919. Electric indicator operated by passage of motor over device in road.

1,478,979. AMUSEMENT APPARATUS; M. Stoehrer and H. Stoehrer, Methuen, Mass. App. filed March 31, 1922. Electric car operated in a special room.

(Issued Jan. 1, 1924)

1,479,001. MOTOR CONTROLLER; R. G. Lockett, Milwaukee, Wis. App. filed Jan. 30, 1922. For motor-driven extractors and other machines having a high moment of inertia.

1,479,012. ELECTRICAL CONNECTION MEANS; J. Sachs, Hartford, Conn. App. filed July 29, 1922. Switch blocks, cut-out blocks, etc.

1,479,017. TELEPHONE HEAD SETS; J. S. Timmons, New York, N. Y. App. filed Oct. 4, 1918. Airplane helmet set.

1,479,019. LAMP BRACKET; D. W. Wilson, Toledo, Ohio. App. filed Nov. 28, 1921. Adjustable.

1,479,033. MOTOR CONTROLLER; C. T. Evans, Milwaukee, Wis. App. filed March 17, 1919. Acclerating direct-current elevator motors.

1,479,051. ATIFICIAL LINE; F. H. Best, Westfield, N. J. App. filed May 14, 1920. Telephone lines of potentiometer type.

1,479,069. LIGHTING FIXTURE; I. I. Hance, Cleveland, Ohio. App. filed April 22, 1922. Means for adjusting vertical position of socket.

1,479,087. METHOD OF DETERMINING FINISHING POINT IN PROCESS OF CONDENSING MILK; F. E. Rice, Ithaca, N. Y. App. filed Aug. 21, 1919. By noting resistance of liquid.

1,479,123. ELECTRIC CONNECTOR; C. I. Wille, Chicago, Ill. App. filed Aug. 20, 1919. Miniature-lamp socket and switch.

1,479,139. ELECTRIC HEATING APPARATUS; O. A. Johansen, Christiania, Norway. App. filed Nov. 20, 1922. Grill plate.

1,479,143. ELECTRIC RESISTANCE FURNACE; G. M. Little, Pittsburgh, Pa. App. filed April 7, 1922. For simultaneous heat treatment of variety of materials.

1,479,146. WIRELESS RECEIVING SYSTEM; R. E. Marbury, Edgewood Park, Pa. App. filed March 5, 1921. Transforming impulses into mechanical action.

1,479,152. DYNAMO-ELECTRIC MACHINE; R. Myers, Oakland, Cal. App. filed March 8, 1921. Electric exploder.

1,479,153. ELECTRICAL MEASURING INSTRUMENT; W. G. Mylius, Wilkinsburg, Pa. App. filed Feb. 4, 1918. Pointer and registration arrangement.

1,479,155. INSULATOR SUPPORT OR BRACKET; C. L. Peirce, Jr., Pittsburgh, Pa. App. filed Feb. 23, 1918. For house-service lead-in wires.

1,479,158. COMMUTATOR MOTOR; J. Slepian, Wilkinsburg, Pa. App. filed Aug. 8, 1919. Method of slow acceleration.

1,479,159. DYNAMO-ELECTRIC SYSTEM; J. Slepian, Wilkinsburg, Pa. App. filed Aug. 15, 1919. Commutator-type motor for railway locomotives.

1,479,160. COMMUTATOR MOTOR; J. Slepian, Wilkinsburg, Pa. App. filed Oct. 6, 1919. Method of slow acceleration.

1,479,164. SAFETY DEVICE FOR CONTROLLERS; J. J. Way, Edgeworth, Pa. App. filed May 18, 1921. Controller cannot be operated unless safety circuit is closed.

1,479,171. TRAIN-LIGHTING SYSTEM; J. A. Clarke, Jr., Edgewood Park, Pa. App. filed July 15, 1920. Motor-generator operated from trolley wire for lighting or charging storage batteries.

1,479,174. REGULATING SYSTEM FOR INDUCTION MOTORS; A. M. Dudley, Oakmont, and C. W. Kincaid, Wilkinsburg, Pa. App. filed July 28, 1917. Similar to "Scherbius" system.

1,479,179. MOTOR-CONTROL SYSTEM; L. J. Hibbard, Wilkinsburg, Pa. App. filed Jan. 5, 1921. Railway motors accelerated singly, in pairs or all together.

1,479,181. IGNITION CONTROLLER; J. H. Hunt, Dayton, Ohio. App. filed Sept. 27, 1918.

1,479,217. ELECTROMAGNETIC BELL; W. H. Bradley, Shelby, Ohio. App. filed Dec. 26, 1918. Weathertight construction.

1,479,250. AUTOMATIC TELEPHONE SYSTEM; W. T. Powell, Rochester, N. Y. App. filed Dec. 4, 1920. Connections between two subscribers made by non-numerical switches.

1,479,256. SPACE CURRENT DEVICE; H. K. Sandell, Chicago, Ill. App. filed Aug. 28, 1919. Four-element electron tube.

1,479,276. CURRENT INTERRUPTER; C. E. Bennett, Atlanta, Ga. App. filed Sept. 2, 1919. Method of relieving pressure in tank after formation of arc.

1,479,284. ARMATURE-WINDING TESTING MECHANISM; J. F. Cullin, Detroit, Mich. App. filed Jan. 7, 1920. Device for testing condition of insulation in coils.

1,479,315. ELECTRICAL CONDENSER AND PROCESS FOR MAKING THE SAME; G. W. Pickard, Newton Center, Mass. App. filed Jan. 12, 1921. By forming metallic depositions on dielectrics.

1,479,316. PIPE CLAMP; R. S. Peirce, Hinsdale, Ill. App. filed Oct. 11, 1920. For grounding electric circuits.

1,479,359. HANGER; F. R. Blake, Bangor, Me. App. filed Dec. 6, 1921. For holding lighting fixture to wall.

1,479,370. ELECTRIC ARC LAMP; L. R. Coffin, Bellingham, Wash. App. filed June 8, 1917. For use in cinematographic, stereopticon or other projecting purposes.